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# Federal Forecasters Conference 1990

## Proceedings

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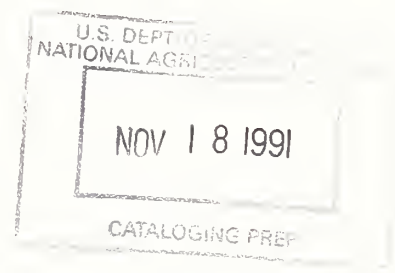
**Federal Forecasters Conference 1990: Proceedings.** Edited by Karen S. Hamrick, Agriculture and Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Staff Report No. AGES 9109.

**Abstract**

This is the proceedings of the third annual Federal Forecasters Conference held on September 6, 1990, at the U.S. Department of Agriculture. The theme of the conference was "The Role of the Federal Forecaster." Contained in this document are remarks made on the theme, which are nontechnical in nature, as well as technical presentations on various forecasting techniques and on forecasting activity from around the Federal Government.

**Keywords:** Forecasting, modeling, projections, econometrics, forecast evaluation, demographics.

The views expressed are those of the authors, not of the Economic Research Service, the U.S. Department of Agriculture, or of any of the sponsors or organizers of the conference.







# **Federal Forecasters Conference *1990***

**Proceedings**

**Cosponsored by  
Bureau of the Census  
Economic Research Service  
Central Intelligence Agency  
Bureau of Health Professions  
National Center for Education Statistics**

**USDA South Building  
14th Street and Independence Avenue, SW  
Washington, DC  
September 6, 1990**

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## Acknowledgments

So many people contributed to the success of the third annual Federal Forecasters Conference, there is not space to describe each contribution. Thanks are due first to the committee members: Ralph Monaco, Stuart Bernstein, Paul Campbell, Debra Gerald, William Hussar, Herbert Traxler, and the Central Intelligence Agency's Methodology Center. Debra, in particular, was responsible for many of the conference details, including the directory. Thanks are due also to the cosponsoring agencies: Bureau of the Census, Central Intelligence Agency (CIA), Bureau of Health Professions, and National Center for Education Statistics. Mary Walsh, CIA, was instrumental in ensuring the feasibility of the conference by her early support. I acknowledge the support of Economic Research Service's (ERS) management--Bob Robinson, Ken Deavers, Tom Hady, and Vicky Smith.

I am grateful to William Dunn for providing us with the keynote speech, and I wish to thank USA Today for supporting our conference. Special thanks to Kirk Rubida for moderating the morning session.

The USDA Economics Management Staff who made significant contributions are Lindsay Mann, Carolyn Riley, Tom McDonald, Sharon Lee, Cheryl Reese, Roberta Paradine and her staff, and Ralph Dillard and his labor crews.

Other USDA employees whose help was indispensable included Larry Sullivan, Office of Public Affairs; Kerry Gorton and Paul Maslyonic, Office of Operations (OO); Sharon Moseley, OO; and Ray Bridge, World Agricultural Outlook Board.

Thanks are due to members of the staff at ERS, Agriculture and Rural Economy Division: Paul Flaim, Linda Franklin, Pat Saunders, Linda Felton, Annette Dargan, Juanita Holder, and Tim Parker. Thanks also to all of the Macroeconomics Section for their patience and support.

The participation of these individuals and organizations as well as that of Federal forecasters made this conference a success.

A handwritten signature in black ink, reading "Karen S. Hamrick". The signature is written in a cursive, flowing style with a long horizontal line extending from the end.

Karen S. Hamrick  
Agriculture and Rural Economy Division,  
Economic Research Service,  
and Cochairperson, Federal Forecasters Conference 1990



## Introduction

The Economic Research Service (ERS) carried on the tradition started by National Center for Education Statistics (NCES) in organizing the third annual Federal Forecasters Conference (FFC 90). The first conference was held in 1988 and provided a forum where forecasters from Federal agencies could meet and discuss various aspects of forecasting in the U.S. Government. In 1989, a second conference was held that focused on forecasting and public policy. The first two conferences were sponsored fully by NCES.

ERS volunteered to take the lead in planning FFC 90, and coordinated the joint sponsorship of the conference among five organizations: ERS, NCES, Bureau of the Census, Central Intelligence Agency, and Bureau of Health Professions.

One hundred and thirty-two forecasters representing 50 different Federal organizations attended the conference at the USDA South Building on September 6, 1990. The theme of this year's conference was "The Role of the Federal Forecaster," which was explored in both the keynote speech and the panel discussion of the morning general session. The 19 presentations in the 6 afternoon concurrent sessions discussed forecasting techniques, methodologies, and models, and provided an overview to the current state of forecasting in the Federal Government.

An additional product of the FFC 90 effort was the Federal Forecasters Directory 1990. The directory is a listing of 235 Federal forecasters. In addition to the alphabetical listing, the directory gives an organizational listing. Also provided is a list of forecasting publications and available forecasts of the U.S. Government. The FFC 90 organizing committee believed that the compilation of the directory was important in allowing Federal forecasters to contact each other, and the committee was pleased to be able to continue the tradition that NCES started of publishing a directory.

In developing a program for the day, the FFC 90 committee wanted to explore the topic of the role of the Federal forecaster from different perspectives. After opening remarks from a USDA policymaker, the audience heard from William Dunn, USA Today, an "outsider" in that he is not in the Federal Government nor a forecaster. The purpose in inviting him to address the topic was that he could provide the perspective of a customer of our work and tell us how effective we are from his vantage point. The committee organized a panel discussion on the theme topic to follow Dunn, with panelists who are senior managers in the Federal Government. The purpose in the panel was to hear the perspective of those who manage forecasters (and may or may not be forecasters themselves) but yet are held accountable for those forecasts by the customers--the White House, Congress, and the public. The afternoon sessions were designed for forecasters to talk to forecasters, allowing for the exchange of techniques and methodology, as well as providing an overview of forecasting

around the Federal Government. The following is a summary of the points made during the day:

Daniel Sumner, USDA, Deputy Assistant Secretary for Economics, welcomed the audience to USDA and assured them that forecasts are fundamental to policymaking.

William Dunn, USA Today, suggested that it is mutually advantageous for Federal forecasters and journalists to work together. He gave insight into how he, as a population reporter, does his job, and how Federal forecasters could more effectively publicize their work. He emphasized the importance of writing in plain English and highlighting the "good story" in one's research. He appealed to the audience and their organizations to take more initiative in publicizing research and he gave some guidelines for talking to the press.

The participants in the panel discussion described the nature of forecasting in their agencies. Overall, they agreed that forecasting is worth the trouble--forecasts are needed for policymaking and policy evaluation. Forecasters could, however, be more effective through communicating with policymakers and, in particular, by anticipating the policymaker's needs and by providing information to the policymaker on the assumptions used in the forecasts. It is also necessary for the forecasts to be timely in order to be useful. There will be a continuing need for forecasts in the future, and one panelist expressed concern about the Federal Government's ability to recruit and retain skilled forecasters.

In the afternoon technical sessions, 19 presentations were made on a broad variety of topics. The presentations included discussion of specific techniques and models, methodologies, forecast evaluation, consistency among forecasts, utilization of forecasts, and overviews of the forecasting activity at several organizations. The broad variety of topics and issues covered confirms the vitality of forecasting work being done in the Federal Government.

# **General Session**

## Opening Remarks

Daniel A. Sumner<sup>1</sup>

My job is to be the official welcomer to the U.S. Department of Agriculture (USDA), so let me get that out of the way by saying "welcome." The reason Bruce Gardner, our Assistant Secretary of Economics, could not be here is because he is on his way to the Office of Management and Budget to talk about the budget summit. What Bruce Gardner is taking with him is, of course, a bunch of forecasts--forecasts of agricultural prices and the analysis that turns those potential price changes into outlays. This is something I think many of you face everyday--forecasting what happens in the world under a policy scenario and forecasting what policy will be.

Our forecasters at USDA face many problems as well while they work. For instance, what is going to happen to world wheat markets depends on many variables, like what will happen to wheat policy in the European Community, or the Soviet Union, or other places. Also, they know if they cannot forecast the weather very well, they will have a hard time forecasting what will happen in the world. It is tough work, and we certainly appreciate it when we use those forecasts to turn them into policy proposals.

The kinds of forecasts we use, of course, are primarily agricultural economic forecasts. But we rely on macroeconomic forecasts to drive some of the particular demand parameters. We also rely on energy forecasts because lots of ethanol-related issues depend on energy issues. Additionally, not only domestic but international forecasts underlie food demand kinds of questions.

All of these factors have to be considered when we are forecasting--they are essential to our work. I know lots of you know that, but I also think it is important to say it to you explicitly on occasion.

I am also fond of telling people that there's one thing we know for sure about the forecasts--they will be wrong. This is frustrating. If we knew how they were going to be wrong, of course, we would change them.

So the fact that the forecasts are wrong does not bother us, given that we know that it is the best we can do. Even if we pretended we were going without a forecast, we would implicitly have built within our analysis some sort of forecast about prices, or quantities, or something.

As we just mentioned, I am on my way to give a talk in Monterey to some grain export people. They are interested in policy

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<sup>1</sup>Deputy Assistant Secretary for Economics, U.S. Department of Agriculture.

analysis about the U.S. farm bill debate going on right now in international negotiations on trade reform. But, fundamentally, they are interested in our forecast about grain markets over the next decade.

So I am going to present to them USDA grain forecasts that will be conditioned on alternative policies. In fact, I will offer those in a way a lot of you present your forecasts which are if this policy happens, here is what may happen to grain markets, et cetera.

They will ask me, which one of those policies will be in effect. I will take some of our Economic Research Service, World Agricultural Outlook Board, and some other forecasts with me, and present them to the folks in the industry. And, finally, we will end up with some forecasts.

So, my job here was to say welcome. My second job I think was to assure you that what you do is used every day, all day, by people who are involved in the policy business.

## Confessions of a Statistical Reporter (Keynote Speech)

William Dunn<sup>2</sup>

Good morning to all my highly placed unimpeachable Government sources. Thanks for all those wonderful statistics you've been feeding me. Keep them coming because without you I'd have no stories to write. But also, without people like me not many civilians--not many regular people--would know about your statistics, and the point of your research is to get the data to the public as well as to the decisionmakers for their scrutiny, analysis, and debate.

While the press and Government statisticians obviously have different perspectives, needs, and goals, we do need one another, I believe. There is a common ground that we can meet on to the advantage of all sides. Being with you today reminds me of a chat I had a while ago with a forecaster at the Census Bureau who came out with a new series of U.S. population projections.

As you know, most forecasters look 10 years or at most 20 years ahead, but these new projections, astoundingly, forecast the population out to the year 2080. I applauded the analyst's confidence and nerve. He jokingly responded that going that far into the future was actually safer than going only a decade or two ahead.

The reason, he explained, was that in the year 2080 nobody reading the projections now will be around then to tell him he was wrong, if he was wrong. The most daring forecasters I've ever encountered though were at the local chapter of the World Future Society. They had a fun brainstorming session last December and so the participants wouldn't feel constrained, they looked 1,000 years ahead. One forecast that stuck in my mind, in the year 2989, a starter house will cost \$5 million.

Joking aside, I, for one, have a lot of respect for what you do despite the critical press that the Government, including the Federal analysts, sometimes get. And I've written some of those stories. Despite that, I view analysts at the Census Bureau, the Bureau of Labor Statistics, National Center for Health Statistics, and the other agencies as being like the social science faculty at a fine university.

Rather than Federal bureaucrats, I consider you scholars and serious researchers, and while you're not always right, your batting average is a lot better than many of the heavy hitters in the big leagues. In your statistical analysis and forecasting, you're doing vital work in identifying and quantifying trends, spotting problems and progress and shifts in how we live, work, and play.

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<sup>2</sup>National Reporter, USA Today.

As you know, given that these various trends, like a powerful steam locomotive, build up a lot of momentum that carries them forward for many years, you provide all of us with that very important glimpse of the future or possible futures. With your forecasts in hand, Government agencies, industry, academia, and even the media and private citizens can attempt to shape or alter the future so that we arrive at the best possible future.

Having said that, I must add that I believe that too much of the Government's rich statistical data just sit there, off in some computer bank or are filed away in some warehouse in Suitland, Maryland. Perhaps the Government is too passive in disseminating its data and promoting its many uses. In some departments and among analysts, there is, I detect, a palpable reluctance to discuss their work, at least with reporters.

Remember, if you don't discuss your work, reporters like me will go to other people to discuss and interpret your work, and those other people may get it wrong or wind up getting the credit for your work. Given the richness and the breadth of data available and its news value, I would urge all of you and your press information offices to be a little more assertive in distributing the data and more willing to explain it outside the academic and Government circles--be more willing to explain it to the civilians like me.

I realize the constraints under which you operate. Still you can find ways, I believe, of touting Government research more and getting it out before a wider audience and more quickly. Instead of sitting back fearful of the random reporter's call, I would urge you to take the initiative a little more in distributing the data, talking up the results, even helping uninformed reporters see the story buried beneath the statistics. If the reporters have any potential, they won't be uninformed for very long about the terrific story material you people are generating.

Before I get to that, though, I'd like to tell you a little bit about how I got here and how I came to be a demographics reporter. Let me give you some insights into the types of people you may be dealing with down the road.

I wasn't always a statistical reporter. Like most people, I used to be intimidated by statistics. I remember a high school geometry or trigonometry class, I got a 93 in the first monthly marking period, but a month later I got a 67. The teacher took me aside, and he said he didn't want me to get too cocky with the numbers.

Earlier in my career I had been covering mass transit, city hall, police, the usual stuff that cub reporters cover. My career, though, was forever changed on a cold winter's day in Detroit in 1976. I was at The Detroit News which had just gotten a new editor-in-chief, Bill Giles, who came to us from Dow Jones.

He had been previously with the Wall Street Journal and the National Observer. He called me into his office one morning

without warning, which made me uneasy. Some people had been getting demoted and reassigned. After hello and how are you, he told me he had a great new assignment for me. Demographics, he said, and waited for my reaction.

I stared back blankly not exactly knowing in 1976 what demographics meant or what he had in mind. But he quickly explained that he wanted me to cover population trends, things like mortality, mobility, fertility, change in the family structure, the evolution of the cities, and changes in the workplace.

Huh? Why me, I thought. Was I being punished? It sounded like a reporter's equivalent of Siberia--worse than a lifetime of writing obituaries or covering zoning meetings. But I am here to confess to you now that I soon changed my mind.

I began to understand what my editor was talking about. I began to realize that there was a terrific opportunity being presented to me, that this was a plum assignment. The further I got into it, the more I discovered the wealth of rich material and important stories out there just waiting to be done and certainly worthy of ongoing coverage.

Demographics and other statistical beats might not have the flash appeal of the Pentagon, or the Mid-East, or covering the White House, or a pennant race. But demographics and the other statistical research being done are every bit as important and potentially just as interesting and compelling if handled properly.

Admittedly, the numbers alone that you produce can be deadly dull and have the great potential to discourage a reporter, and put his or her readers to sleep, or force them to put down the newspaper and turn on the television. It's not enough to just scoop some newly released statistics and merely report them undigested as some reporters do.

Too often the numbers are presented that way and clearly would be uninteresting if not incomprehensible to the reader. The challenge for the reporter is to analyze the numbers, dig below the surface and get beyond the numbers to the people and the lives that the numbers are quantifying.

Let me give you an example. The Bureau of Economic Analysis at Commerce a few months ago came out with the latest income figures. I believe they were for 1988. USA Today and everybody else dutifully reported the numbers, but we decided to go back for a closer look. We decided to take a different approach.

When we realized that 46 percent of the households had income under \$25,000 a year--this is in 1988--we thought that that was an often overlooked and an astounding fact. It certainly astounded my yuppie editors. So I wound up going to Joplin, Missouri, because it's practically dead center of the Nation, and

also demographically, it was perfect. That's where people do indeed live on less than \$25,000 a year.

We just let them talk about themselves, their lives, the simplicity of their lives, and they were eloquent in what they had to say. They were not deprived, many of them, as we might have thought. The story was completed with some analysis from the experts, economists, demographers, and statisticians. The ones that got quoted then and the ones that get quoted most often by other reporters are those that have something to say and can say it in plain but compelling English.

If I have one beef against demographers and other statisticians that I deal with, it's that too many of them talk as if they were writing for an academic journal. They speak in compound, complex sentences, and are overly cautious and noncommittal with a fondness for dependent clauses. There's a decided aversion to speaking simple declarative sentences. That's tough to take and turn into punchy quotes.

Yet, there are some who are wonderful interviews and who provide good copy but also telling and accurate comments that truly reflect their work. One fellow comes to mind--geographer Truman Hartshorn was talking recently about the growing importance of the suburbs. He caught it all when he observed the suburbs are no longer sub to the urbs, and then he went on to explain what he meant, but that was a terrific quote.

Let me tell you quickly how I operate at USA Today. I probably propose about 60 percent of the stories that I report on and some of those have been suggested by some of my various sources, including people in this room. The balance are assigned to me by my editor. The stories that I propose occur to me in a variety of ways. I read widely not only for enjoyment but also looking for story ideas and leads. So I scan five or six papers a day, often a dozen magazines a week, including American Demographics, the Futurists Numbers News, Demography, and so on.

Then there's the mail which I quickly but thoroughly scan. Each day I must get 20, 30, 40 pieces of mail and now stuff is coming in on the FAX machine. I'm on countless mailing lists from various Government agencies, congressional committees, think tanks, universities, and marketing firms. In most cases, the mail comes from the press office or public information office of the agency that's writing. The Census Bureau has an excellent information office; it's first rate. They must send out hundreds of reports and many hundreds of releases a year.

After the mail, I work the phones calling up researchers, like yourselves, directly to find out what they are working on, or the press offices of their agencies to find out the release dates of upcoming reports. For example, each week I call the Census Bureau's Press Information Office for what they call their "Monday Report" which lists all the reports and releases tentatively due out the following week.

I do this with other agencies where possible, though many others don't work that way unfortunately. At the same time, I'm always thinking what we call enterprise stories which are not prompted by a specific event or report but rather reporter's initiative to explore a given topic.

I pull together a periodic list every few weeks of story proposals which I submit to my editor and I blend the upcoming reports with the enterprise proposals. Some of my recent enterprise stories--just to give you an idea of the types of things I'm doing and looking at and considering--some of the recent enterprise stories that I particularly enjoyed working on included Okies from California now returning back to Oklahoma to retire.

Another was the census in the year 2000, how it's going to be different from 1990. Another was the forgotten poor, the people of Appalachia, and yet another was a profile of New Hampshire, the exception to the rule, the boom State and the bust region. My editors look over the list of story proposals that I submit and tell me which ones to pursue and when. They also add to the list with their own assignments, and that's how I pursue the news.

In all cases, regardless of whether it's a hard news story or an enterprise piece, I try to include the comments of real people being charted in the statistics we're reporting on. We do this for a few reasons. It personalizes the story, making it much more easy for the reader to identify with. Also, the comments of real people are often as perceptive and analytical as those of the experts.

So I blend the comments of real people, as we call them, with the statistical experts and include my own analysis. After 14 years on this beat, I've become something of a self-taught demographer. While many of my stories and others in USA Today are accompanied by charts, the stories themselves, you may be surprised to discover, are not loaded down with statistics. Rather, I try to use them sparingly in the middle of the story to quantify the trend at hand and to support the assertions being made in the lead and the comments of the other people being quoted.

Which brings me to you. You know how I operate. Let me make a few suggestions on how you might proceed to get your statistics in print, and more widely distributed, and also thoughts on how to ensure that the numbers are used correctly, and you are being quoted accurately.

When I started doing all this 14 years ago at the Detroit News, there were only a small number of general interest dailies and weekly publications that gave ongoing coverage to demographics and related fields. But the number of publications covering demographics has clearly increased, and the quality of the coverage can be improved with your assistance.

For starters, it helps a great deal if you and your organizations have a solid and enthusiastic press information staff with extensive contacts in the media. They can be especially effective if they themselves are former reporters. They know how to approach reporters and they know what reporters need. These are the people who often prepare the press releases of the various Federal agencies, and they are the ones who distribute the releases and reports to the media.

They can be the go-between, between you and the reporters. They can alert reporters to upcoming reports, or propose general story ideas and suggest appropriate experts to call for comment. If you don't know these people at your agencies, I would urge you to get to know the press officers. Give them advance warning when a study of yours nears completion so they can gear up to promote it. Tell them that you are available as an expert commentator if a reporter ever calls blind needing an interview on a subject that you are familiar with and prepared to talk about.

Getting back to press releases, I believe it's beneficial to issue a press release along with a news report as the Census Bureau always does. Some agencies do not do this though, preferring just to release the report. I think that's a mistake. The advantage of the press release is that with the approval and, perhaps, the coauthorship of the analyst behind the actual report, the press release highlights the report and summarizes it.

This is a tremendous help to the rushed reporters. It points them in the right direction and also minimizes the possibility of misinterpretation. Also, reports and press releases, I think, should be embargoed, as they say. That means you should send them out a few days before the release date. Again, not all Government agencies do this.

By embargoing a press release, this allows plenty of time for delivery and receipt. Every reporter gets the same start. Without the embargo date, some reporters inevitably get the reports sooner than others which just antagonizes reporters who missed it. But another and the most important benefit of the embargo is that it allows time to alert editors to the story and gives reporters additional time to prepare a thorough article rather than rushing to bat the thing out in 2 or 3 hours because it just came in this morning and it's for immediate release.

Assuming your agency does have a press office, they and you should develop a list of press contacts, reporters, and editors that write about your topic. You and the press office should get to know the reporters, at least by telephone. These are the people who should be getting your reports on a regular basis. You can find out who they are by simply scanning the publications to see who is writing what, who is covering your field.

Also ask colleagues and check with professional associations in your respective fields who often maintain very good press contact lists. Don't be afraid to send your releases and reports to more

than one person at a publication because oftentimes reports and the resulting stories cross beats in departments. You want to let all the appropriate people know something big is coming out.

Those occasional times when two or more reporters are independently interested in the same story, it will quickly become apparent at the daily editors' meetings where various editors and departments pick stories from the reporters. You might occasionally follow up a specific press release on a particularly newsworthy report with a well-placed telephone call to the managing editor or the beat reporter to remind them of the upcoming release and to offer suggestions--suggestions on how to pursue the story and leads.

Smaller publications may need some general prodding to get them to start covering your reports, at first anyway. I would encourage your press information offices or you yourselves to write or phone the smaller publications, and ask for the managing editor or the appropriate person who might be interested in such and such.

Given the broad range of research represented here today, you might find an interested reporter on the urban affairs beat, the military beat, the financial desk, or then again it might be somebody in the lifestyle section or urban affairs. Pursue several angles, give them a crash course in the reports you're putting out and how they might make for solid stories, and be sure to add them to your press list.

To give you an example of how one agency I think effectively approached news organizations to tout their work, I point to the Census Bureau. In 1982, with the 1980 census results about to start flooding out the demographic reports, the Bureau sponsored a dozen or so seminars around the country for reporters and editors to alert them to familiarize themselves with the flood of data about to pour out.

None of this was news to me. I was already well-immersed in the demographics beat but it clearly was eye opening for the few hundred people who attended these seminars and it resulted in many papers starting demographics beats and beginning to cover census and related data regularly.

Speaking at these seminars were several analysts from the Census Bureau who gave crash courses in their fields. They even made story suggestions. A press officer was also on hand to explain to reporters how the Bureau operates, how they disseminate the data, and there was usually a talk by a reporter who used census data on a regular basis. I gave a couple of those talks. The reporters and editors who attended these sessions left with an armload of recent reports, a 7-pound statistical abstract, a telephone contact list, and some terrific story ideas.

I would encourage the Bureau to do it again in 1990 or '91, and the other agencies to follow their lead. You might cosponsor such a seminar with a journalism school or a newspaper group or

one of the journalism professional organizations, such as the American Newspaper Publishers Association or the American Society of Newspaper Editors. One point to make at these seminars is that news stories are improved, strengthened, and given authority by the deft and proper use of statistics. I believe that, and I am sure you do, too. Let's start talking up that point with the reporters and editors that you have contact with.

Another point to make is that the report and their findings aren't old news just because the report came out last week, or last month, or last year. At first it took me a while to realize that, but I did come to discover that sometimes the best information is months or even a few years old. It's also the latest information.

For those of you who don't have a big or aggressive press office, you might have to take on more of the burden yourselves that I have been discussing and begin to promote your own work a little more.

I know this is a delicate matter but it can be done, and if you want to bring attention to your agency and to get your work out there and discussed by as wide a group as possible, it's worth the effort. Just a few well-placed phone calls or a note to the right people at the right organizations can get it started.

Whether you're doing the calling or your press office, don't forget the Associated Press (AP), United Press International (UPI), Reuters, and the supplemental news agencies, like the Gannett News Service, which I write for. The Associated Press and UPI, in particular, daily publish what they call a daybook of upcoming events and reports due out. This is sent to newspapers all over the country, all over the world actually.

This daybook regularly lists reports coming from the Commerce Department and the Census Bureau, tipping reporters to their upcoming release and giving the contact, the author of the report, or the press aide who can direct you to the right people. But many of the terrific reports produced by other agencies are not routinely listed this way and they should be.

So I would urge you to get your reports, check with your press offices, and find out if you're alerting AP and UPI to include them on their daybooks. If not, then start. If you don't have a Rolodex--I have three, by the way, loaded with all your names and hundreds more with cross-references by area of research--but if you don't have a Rolodex for reporters, get one and start filling it up.

It may seem awkward at first talking with reporters and seeking them out but once you get to know them, it becomes easier. We're not the tough guys that some Government people think we are. Remember, reporters are always looking for stories. We are hungry for them and have to produce them, and we need you.

Over the years, I've encountered a few researchers who have simply refused to talk to me about the research, dismissing me as somehow beneath them or a civilian not worthy of talking to--a reporter from the popular press. I think that's a counterproductive position because it only redoubles a good reporter's resolve to get the story with or without the researcher's help.

Some others, perhaps having been burned by reporters in the past, have proven reluctant interviewees. I can understand how that can happen. Still I contend that the best policy is for the researcher to deal openly with the press. In talking with reporters, remember a few things. They are usually up against tight deadlines, often having to gather information from several sources in several hours, sometimes less.

Then, they have to write a coherent story in an hour or two. Unlike social scientists, reporters don't have the luxury of several months or even years to produce the results. We are under constant deadline pressure. Reporters are also looking for quotes and analysis. The etiquette can vary, but when a reporter is talking to you, they assume that you are willing to be quoted.

If you want to set ground rules, do it at the outset of a conversation, not at the end. It's a waste of everybody's time to talk to reporters for 10 or 20 minutes, and then conclude by saying, "I don't want to be quoted." My own position is that you can't set the ground rules after the game has been played. So set them at the outset.

More and more reporters are being instructed not to use blind quotes. At USA Today, we're forbidden from using quotes without attribution. So if I can't quote you, I really don't have the time to talk to you. If, however, during an on-the-record interview, you do come to some matter that you want off the record, simply tell the reporter--we're going off the record now, and I'll tell you when we go back on the record. Then when you reach that point, simply say, all right, we can go back on the record now.

Sometimes, particularly if the data are complicated or sensitive, I use a tape recorder in the interview with the permission of the people I am talking to. This way I don't miss anything and I get it all right. Some people don't like being taped. Actually, it's in their best interest, too. Again, it cuts down on the likelihood of misinterpretation or misquoting.

Obviously, when talking to reporters, you want to speak thoughtfully and not off the top of your head. If at all possible, give yourself some time before a telephone or in-person interview to collect your thoughts and to make the points you want to make. In the interview, again, speak directly and avoid "academeeze" which makes for confusion and terrible quotes.

The reporter is trying to make sense of technical material so he can understand it, and then make it understandable and compelling

to readers. The expert has to help by making the explanations understandable. Remember, you're talking to a reporter not a fellow social scientist.

Also realize that news space is tight, especially in USA Today. But even other newspapers trim stories. So stories and quotes must be tight and hopefully bright. You don't have to force it or speak in canned sound bites, but there is nothing wrong with bright catchy quotes. Analogies and examples are also very helpful in making sense of the numbers. Those of your colleagues who often turn up in the media do so not only because of their brilliant research but their knack for explaining things to the lay person in a compelling and direct way.

Some here--and you know who you are--are excellent at it. Some also get repeatedly called, not just because they have their own studies coming out but also to comment on the work of others. They're often called because their names appear on expert lists. Again, the Census Bureau has a 4-page sheet with the names of specialties and office phone numbers of their top analysts. There you can find people to comment on everything from aging to the demographics by zip code.

They even have people to tell how much tuna fish we consumed per capita last year. I have that expert list and lists from leading universities, think tanks, and other organizations on the top of my desk, and I use those lists often. Occasionally a source will ask or require a look at, or a readback, of the story before it goes into print, and I always decline, as do most reporters.

First, there's no time to do it and then engage in haggling over the story. But more important, I don't want to compromise my independence and freedom as a responsible reporter to write the stories as I see fit. I don't want my sources to become my editors. I already have enough editors.

However, I would encourage sources to call back if they have any additional thoughts or questions, and I always tell my sources that I will call them if there is anything I don't understand or anything that needs amplification. Believe me, I often call sources back two and three times in a day for more information, bothering them, I'm sure, but it's in the best interest of not only protecting me but in their best interest because it gets the information right to the readers.

I want, above all, the stories to be accurate. In USA Today, it's my name that goes above the stories which are read by over 6 million people, and I don't want to look bad in front of them nor do I want to hear from them, and believe me when the stories are wrong, I do hear from them.

Let me conclude by offering what I've found to be the most important statistic on the demographics beat and that's (301) 763-4040. That's the telephone number of the Census Bureau's Press Information Office which is my life blood. I'd like to

suggest a second very important statistic for all of you, which is (703) 276-3400--that's my number at USA Today.

I'm in regular touch with a good number of the people in this room but not all of you, and I would like to hear from all of you. For the others, please take down the number and give me a call if you have a story idea or a new study you'd like to get into print.

As I tried to demonstrate through my comments, despite all the tensions between the press and Government reporters like me, and statisticians like you, we need one another. By realizing each other's concerns, deadlines, and interests, I believe we can successfully cooperate and achieve our similar but different goals.

Thank you, and keep forecasting.

### Questions and Answers

**Participant:** Just a comment to get things going here. Before I worked for the Government, I was an economist for an international bank. Our chief economist had a rather wide guideline, you might say, for us as to whether or not to talk to reporters. He said if you talk to a reporter, you'll be misquoted about 50 percent of the time. If you don't talk to a reporter, you'll be misquoted 100 percent of the time.

I haven't been able to convince my current employer that that's a good strategy, but for most of the agencies here, I suspect Mr. Dunn has provided us with some interesting examples of methodologies of selling our wares.

It occurs to me, though, I'd like to ask his advice on one problem I found when I was out in the real world talking with reporters. I would spend a half hour or an hour talking to a reporter about a substantive issue--international finance, economic development, or fall of the dollar and rising inflation. I would go through all the substantive arguments and basically wind up, when the piece came out, with the most pejorative, emotional thing that I happened to say during that hour being the only thing of mine that got into the piece.

I certainly found myself reflexively saying I don't want to talk to reporters, all they want from me is emotion, they don't want information.

So let me address this for you, and perhaps you can give us some advice on how to deal with people who have a reflexive reaction to talking to reporters.

**Mr. Dunn:** Well, it does happen. I think people in your position with any experience in time come to know who those reporters are,

and I don't think they are typical. They're not the majority but they exist. One has to deal cautiously with them. But also with experience you get to know who the serious, the fair reporters are and can be more expansive with them.

I would just caution everyone when being interviewed, everything you say can and may well be used against you. As I said a few minutes ago, be thoughtful in what you say, and never talk off the top of your head. Collect your thoughts and deliver them directly.

If what winds up in the paper is wrong, I would call the reporter and ask for a correction. If you get no satisfaction, I would call the managing editor.

Corrections are made and, believe me, reporters don't want to be caught making errors. You can print a correction, but if you have a lot of corrections appearing in the paper regarding your stories, you're in trouble.

Also, this points up the advantage of having an aggressive, experienced press information office at your university or your Federal agency, or think tank, and many of them have excellent people. Again, typically they're former reporters and they know what it's like on both sides. They can run interference for you, perhaps prep you before an interview, and give you some hints on how to present your thoughts to best advantage.

**Participant:** This dialogue you're encouraging between researchers and staff and the press is supported by a large number of people. But in fact, the practicality is that in a number of agencies, individuals are absolutely discouraged by agency policy from talking directly to the press.

So what you're doing is contacting a press office, and I wonder how we can get more encouragement for those press officers to trust experienced and professional staff in dealing directly with the press. I'd appreciate your view on that.

**Mr. Dunn:** I would hold up, as an example, the Census Bureau, but that's the one agency that I have the most experience with. They have a very large effective staff, and they do many things right. There are some things they could improve, but they do many things right. So perhaps other Government agencies should look to them, should talk with them, and maybe come in for a day and see how they operate and take some lessons from them.

If they can do it, why can't the others? Certainly, they're dealing in some sensitive data. For example, coming up at the end of the month is the 1989 Income and Poverty Report. Now that's something that has some very sensitive material in it and policy implications that some probably want to avoid because of the trouble that's going to result when the numbers are publicized.

But the Bureau, realizing that they're going to hear from people anyway, goes on the offensive. They'll have a press conference at main Commerce downtown, and they'll have top people from their income branch to present the data, and then field questions. That to me is the best way to do it--to go through you, the researchers, to take your data and go on the offensive and present it the way you want to present it and explain it to the lay people, including reporters, so that they can best understand it.

If you don't do it that way, the data are still going to get out. But if you don't present it that way, if you don't present it to best advantage, you're just increasing the likelihood that there are going to be mistakes, and people are just going to take your report and run with it, and make a lot of misinterpretations and go to people outside your agency, people not familiar with the data, to offer their own interpretations.

It just seems to me that you'd want to maintain as much control over your data as possible. To do that you just can't shrink from contact with the press, even though that contact, I know, can be draining and difficult sometimes. But it's just part of your jobs, I think. You do have a responsibility to get the data out there.

**Participant:** I think for some of us, since we're so into our particular specialty, we find it hard to define what the public would find interesting. I was wondering if you might have some thoughts on that, as it seems like it's often something that's either trivial or entertaining that gets lifted out.

I work in the Internal Revenue Service and there was a study done about tips, including the whole issue of how to handle withholding tax. What the popular press picked up, which got very good coverage, was the different tipping at an Italian restaurant versus a Chinese restaurant.

Are there some rules of thumb that you think are the things that catch the general public's imagination or interest?

**Mr. Dunn:** Well first of all, that was a very good story. What you might have done though is use that as a wedge to get more coverage for the other findings in the study. You might have collected the papers and news magazines, see who wrote the stories, and then gone back to them and complimented them on the story and tell them there were some other good findings in there, maybe not as funny, but just as important and revealing, and why don't you take a second look at those.

As I said earlier, sometimes you have to point reporters in the direction. You have to lead them to the news. Reporters are desperate for stories. It's a deadline every minute and you're only as good as your last story. So they are constantly hunting for new stories. If you come up with some good story ideas,

you're making their job easier and they'll thank you, and they'll come back to you again.

But as far as what stories editors want, and reporters want, and readers want, obviously it varies by publication. But in general, I think readers want to read about themselves. We're all interested in our own lives, and, not to be overly simplistic, but we want to read about how we live, work, and play. That's what you people are quantifying. So if you can spot a trend that addresses any of those things, and can make it understandable to people and bring it home to them, I think that story could fly.

Let me give you an example. Every year the Census Bureau and the National Center [for Health Statistics] come out with new figures on fertility rates and birth rates, which is really boring stuff. So when I was arguing with an editor about boring but important, he just wanted to dismiss it. But I said, no, this is important stuff and we told the story through the impact that the dropping fertility rates had on neighborhoods. We explained the impact, the repercussions of the falling fertility rates on schools that were being closed because of the baby bust and experienced teachers that were being laid off because there were not more children to teach, and neighborhoods that once had a lot of children that were now aging and had very few children, and the impact that this has on the economy.

So that became a story that really grabbed the reader's interest because we showed how these statistics, these incomprehensible statistics, affect them on a personal level. When writing a story I ask myself, "So what? Why should I care? Why should the reader care?" If you can explain the connection between your numbers and how it affects people's everyday lives, then you are improving your chances to get good coverage for it.

Even though there is a lot of popularizing in this, I don't think you're prostituting what you're doing. You are getting it out to a wider audience and getting people thinking about what can be very intimidating and unpalatable numbers. In time as they become familiar with the stuff, maybe they will go on to the next level of scrutiny and discourse.

**Participant:** Could you offer some comments on your feelings about the accuracy of forecasts? In other words, after we make these forecasts, does anybody ever go back to check and see how reliable they are? Also, aside from Government forecasting, there is a large consulting group out there that does this for quite a bit more money than Government bureaucrats generally get. If you have any feeling for the accuracy of their forecasts, too, that would be useful.

**Mr. Dunn:** Well I think you do a pretty good job given the conditions you operate under and the many unknowns. Again, what I'm most familiar with are the demographic projections, and the

Census Bureau in its population projections releases three or four series based on different assumptions.

When you're releasing that many series, one of them is bound to be right or accurate. It's something that has to be done, and there are a lot of risks, and inevitably there are going to be some errors or some discrepancies. If we could get the economy to stay at a certain level and if people behaved, continue to have children at a certain level, then the forecasting would always be right. But there are too many things that change. So you are unfortunately in a business where you are bound to make errors, but that's part of the excitement. In general, you're right or in the ballpark more times than you're not.

As far as the private forecasters, most of them, it seems to me, are starting out with Government data. So I don't see how they could do it any better than you can. They are just charging money for it. But census data, the Bureau of Labor Statistics, it's all the basis on which all these think tanks and these consulting firms base their own extrapolations on. And where they might get it better is when they go into a very small market and can better control the variables or when they are looking not so far ahead.

We use a fair amount of the private data for our stories but I don't think they are any more accurate. The thing is it's like politicians and their promises. Nobody ever writes them down and keeps them for future reference. Nobody ever goes back and sees what somebody said 10 years ago to see how accurate they were. Maybe we should start.

**Participant:** The current controversy over the 1990 census in some sense involves a comparison of the census counts against the population estimates that the Census Bureau projected for 1990. Any comments on that and how the controversy is being handled by the Bureau?

**Mr. Dunn:** Well the Bureau, it seems to me, has an impossible task to count literally everyone in the country, and clearly they are not going to do it, which they readily admit.

No matter what they do, they are going to be criticized. As somebody said the other day from New Hampshire--which is one of the States that had explosive growth during the '80's and they are very happy because it will mean more Federal dollars and other advantages--"We're delighted with our numbers and we think they're accurate."

But he went on to say that in every census, there are winners and losers. The losers are the ones who are going to find fault with the numbers. Clearly, there are errors in the numbers and a lot of people have been missed. But it's not over yet and they are now going to the local review, and clearly they have spotted in places, like Los Angeles and New York, sizeable omissions of neighborhoods and apartment buildings.

I've been told, and I suspect, the final number--to be released in December, and then the local numbers in April--will be up by 4 to 5 million which would then bring them back closer to the estimates.

Now, as you may know, the municipalities are in the middle of their 15-day local review with their racing through their computer analysis, spotting errors which they then bring to the Bureau's attention for correction. Believe me, they are spotting plenty of errors. So the numbers, without doubt, will be rising locally and at the State level and nationally.

## **The Role of Forecasters in the Federal Government**

### **(Panel Discussion)**

**Editor's Note:** The topic of the panel discussion was the role of forecasters in the Federal Government. The intent in organizing the panel was to get the perspective of those who manage forecasters within the Federal Government, but yet are held accountable for the forecasts by outsiders. The panel members were instructed to describe the problems encountered at their agencies, and to give their candid opinions on how forecasters could more effectively present their forecasts. Kirk Rubida, Central Intelligence Agency, served as moderator for the panel discussion.

### **Signe I. Wetrogan<sup>3</sup>**

At the Census Bureau, we regularly prepare various types of projections. Prior to developing any of our projections, we as forecasters in the Federal sector should be examining the demand for our products. We should be asking the question: "What is it that our users want?"

In fulfilling our user's demands, however, we as forecasters in the Federal sector are subject to several constraints. These constraints are data availability constraints and bureaucratic or organizational constraints.

#### **Who Are Our Users and What Are Their Demands?**

At the Census Bureau, we have a general task to develop population projections. These projections are not mandated to fulfill any particular policy or program requirement. Because of this, our users cover a wide range of the spectrum. As you heard William Dunn say earlier, the Census projections often become the subject of media articles. Because of this publicity, one of our largest categories of users is the general public.

Other Federal technicians often rely on the Bureau's population projections. Sometimes, these projections become an essential input to other projection products. Many Federal program managers and policymakers use our projections to answer important program and policy judgments. In addition to the Federal users, we regularly respond to many State and local users.

Even though we serve a wide variety of users, they all seem to have one thing in common. They all seem to want more of whatever we can develop. They want more characteristics. They want smaller geographic areas. However, we must balance these

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<sup>3</sup>Demographer, Population Projections Branch, Bureau of the Census, U.S. Department of Commerce.

requests against our two constraints: data availability and bureaucratic/organizational.

### Data Availability

Projections are only a conditional statement. Because of this, we could always come up with assumptions to feed the projection model and answer almost any question. However, in the Federal sector, I think we have a responsibility to do rational projections based on reasonable assumptions. As such, we are constrained to the availability of data. We need to analyze and interpret current data in order to develop reasonable and responsible assumptions to feed our projection models.

The constraint of data availability is not unique to the Federal sector. It is also operating in the business, private, and academic sectors. However, we, in the Federal sector, need to feel particularly vulnerable to this constraint.

### Bureaucratic/Organizational

I include the issues of consistency and duplication under the bureaucratic/organizational constraints. Many persons in this room prepare some type of projection. Often the output of one projection becomes an essential input to another projection. Those of you preparing education or labor force projections often incorporate the Census population projections. Because the results of one projection model often become the fuel for another model, we must recognize and understand the basic assumptions that feed each of our projection models. The consistency of assumptions across projections is an important factor.

In addition to consistency across projections, we need to be consistent within sets of projections. For example, in preparing State population projections at the Census Bureau, we operate under a special constraint. The sum of our State projections should equal the U.S. projection that we also prepare.

The issue of duplication is important to the Federal sector. Sometimes, different agencies prepare projections for similar characteristics. Although we may feel constrained and even embarrassed, duplication of efforts is sometimes very good. However, in the Federal sector, we need to understand the differences between similar products and adequately explain these differences to our users.

Although I've discussed data availability and bureaucratic/organizational issues as constraints to doing projections, I do not feel particularly constrained in the ability to do my job as a forecaster in the Federal sector. I view my job as a challenge. I am challenged to anticipate the questions our users will be asking, challenged to find and interpret reasonable data to fuel projections models, and challenged to make the projections we do produce, interpretable and usable to policymakers, program managers, and the general public.

## Howard V. Stambler<sup>4</sup>

Over the past several decades, the Bureau of Health Professions (BHPr) has maintained an analytical and forecasting program for health personnel. Its major objectives have been to develop forecasts of health personnel supply, requirements, and geographic distribution. Although the Bureau's staff and dollar resources for this activity have generally been very limited, the program has developed and published dozens of projections and seen them used (and misused) by a wide audience both inside and outside the Federal establishment. As such, I believe that a brief discussion of some of our experiences and observations on the role of forecasters in the Federal Government can shed some light on the topic. In particular, I would like to provide some insights about projections that the Bureau has gained over its history and some of the ground rules that I believe can make forecasting more useful and more readily accepted. These are not necessarily in order of importance.

First, we need to emphasize the longstanding difference between projections and forecasts. When the word "forecast" is used, we often mean an unconditional prophecy or prediction, and since we are well aware of the numerous unforeseen events which could upset any forecast, we need to warn the user of this danger. The word "projection" is often used to distinguish the conditional prediction based on an extension of past information from the unconditional "forecasting" prediction. Our economic, social, and personal lives are much too complicated to permit the use or existence of unconditional forecasts or to simply extrapolate past history. The best that can be achieved is to form a judgment as to the most probable course of events, including certain assumptions, both explicit and implicit about the future. All projections inevitably include a large element of judgment and also inevitably are subject to some margin of error.

Second, projections are always subject to the implicit assumptions we make, which are not and cannot be clearly articulated by the author nor fully recognized by the reader. We need to work toward reducing the scope of vague or implicit assumptions and replacing them by a structure of explicit and hopefully quantitative assumptions. But, as we all know, this is easier said than done. Nevertheless, users need to be provided with as much information as possible on the assumptions employed in forecasting models and the implications for their users, for example, through sensitivity analysis. Furthermore, considerable attention should be devoted to the selection and description of the assumptions on which projections are based. At the least, they should include a clear, concise statement of the major assumptions, if at all possible in quantitative terms.

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<sup>4</sup>Director, Office of Data Analysis and Management, Bureau of Health Professions, Health Resources and Services Administration, U.S. Department of Health and Human Services.

Third, alternative assumptions should be provided whenever possible so that relevant alternative forecasts and, hence, policies can be evaluated. Projections which go far into the future and are clearly aimed at pointing out problems, or clarifying, or contradicting existing common wisdom pose particular concerns and are bound to be disagreed with. Unfortunately, many criticisms of projections are simply a reaction to the assumptions which the criticizer would have made differently.

Fourth, we need to carefully emphasize the sensitivity of the forecasts to reasonable alternate assumptions. We always try to do this. Sometimes we succeed, sometimes we fail. One continuing problem of ours has been the point estimates of surplus and shortage. For example, when our calculations result in a surplus or a shortage of 10,200 or 25,700, on a base of 750,000, too much of the policy community reads this to mean a real problem. Similarly, when we predict a surplus or shortage of 10,200 or 25,700 now, we are also talking about slight changes at the margin of how health care is provided. But somehow we can never get this message across clearly. This is a continuing challenge for us, and for you. How do we get across the information of what our results mean?

Fifth, we need to keep in mind that any published (or even unpublished) forecasts reach the hands of many different types of readers and users. In the case of BHPPr, for example, our forecasts are reviewed, evaluated and used by the Bureau, the Department, the Office of Management and Budget, the Congress, professional and educational associations, the general public, and, perhaps our most difficult and critical audience, researchers and analysts. They are all looking for different things with different levels of interest, knowledge, and expertise. Thus, projection reports and studies need to be clear, concise, and easy to understand, but they also have to be complex and technical in development.

One related issue that we have found to be essential in avoiding criticism and enhancing usefulness and acceptance of projections is a very clear and concise explanation of what the requirements projections are all about. Over the years, the Bureau has developed or supported development of projections based on demand, need, adjusted need, utilization, and professional judgment. Each of these approaches has its own place in the information arsenal of policymakers, but it is essential that we identify what we are forecasting, to lessen their possible misuse. Tied to this is the very important need to caveat projections, their strengths, and weaknesses and what they are not intended to be. Let others know what we ourselves know--that forecasting is a hazardous and little appreciated activity composed of part science and part art. And let them know that those who develop forecasts are more aware of their weaknesses than anyone else. In a sense, we should be open in identifying problems before others identify them for us, often not very gently.

In conclusion, let me say that I believe that forecasting is a noble profession. But like economics, it is difficult, little appreciated, and widely misunderstood. If, as Coach George Allen said, "the future is now," forecasting would be a lot easier.

## John M. Rodgers<sup>5</sup>

I started my professional career as a market research analyst. At that time, I asked a very knowledgeable fellow who I was working with, what was the key to being a successful forecaster. He said the key is being able to run faster than the numbers can catch up with you, and I've been running ever since.

I'd like to take just a moment to preface my comments about forecasting in the Federal Aviation Administration (FAA) to clarify what the FAA does. We are not an economic regulatory agency. We did not succeed to those functions which were formerly those of the Civil Aeronautics Board. Instead, we have three functions.

We regulate the safety aspects of aircraft operation, airlines, and manufacturers. In that sense we're a traffic policeman. We are also a provider of air traffic control services and in this context, we are analogous to a very large Federal public utility. Lastly, the FAA administers a grant program of several billion dollars a year. So for some, we're a Federal philanthropist.

I'd like to say that while the Federal Aviation Administration does disseminate forecasts on various aspects of the aviation industry to the general public, our prime impetus for forecasting is agency management and public policy formulation. The Federal Aviation Administration utilizes forecasts to establish its budget requirements, to allocate scarce resources, and for policy-setting purposes. To provide top FAA management with the tools to accomplish these objectives, my office develops national forecasts of aviation traffic and fleet, and national and facility forecasts of FAA workload.

Our forecasting horizon is normally 12 years. Some of the key statistics that we forecast include air carrier revenue passenger traffic, air carrier fleet size, air carrier fleet operations, commuter airline revenue passenger traffic, general aviation fleet size and hours flown, aircraft operations at FAA towers, instrument aircraft operations at FAA facilities, and whatever else the administrator happens to dream up at the time.

The timing of these forecasts is basically geared to the Federal budget cycle and directly influences our staffing levels. We use the information to answer the question: how many air traffic controllers will we need over the next 5 years? The FAA has formal standards which relate workforce to total workload. Because it takes years to fully train controllers, there is a need to provide 3- to 5-year forecasts of activity. Forecasts of future traffic levels are also used to determine the need for navigational aids, towers, and other FAA facilities as the demand for air transportation increases.

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<sup>5</sup>Director, Aviation Policy and Plans, Federal Aviation Administration, U.S. Department of Transportation.

The FAA, as a matter of policy, has to assure that the benefits of its facilities--control towers, landing gates, et cetera--exceed the costs of services provided over the life of the facility. Because both the benefit and cost of facilities vary with facility workload, forecasting this workload is extremely important in making good investment decisions.

State and local planners also rely on FAA forecasts to plan for airport expansion, assuring that adequate runways, taxiways, and terminal space and facilities are available at their airports to meet future demand. For example, should airports in Denver or Chicago be sized to accommodate 50, 75, or 100 million passengers 10 years from now?

Major airports and facilities take at least 10 years to build and our forecasts need to be appropriate and accurate. The aviation industry also finances, through ticket taxes and other fuel taxes, a Federal trust fund which we use to expand and develop the national air space system.

It is our responsibility in the Federal Aviation Administration to estimate future trust fund revenues and to budget expenditures consistent with available funding. This must be done under both existing authority and in preparing requests for new authority. Forecasts of aviation traffic provide policymakers with a significant tool to make critical decisions in allocating trust fund revenues and preparing proposals regarding tax change.

In the policy-setting arena, forecasts allow the FAA to evaluate issues, such as aircraft noise mitigation. How many people and what geographic areas will be subject to how much aircraft noise? What should be the timing of the phaseout of stage-two aircraft and the replacement with quieter stage-three fleet. Stage-two aircraft today make up most of the air carrier fleet. However, they will not meet new noise standards without retrofitting their engines. The policy issue to be determined is the tradeoff between lower noise levels around airports and the economics of retrofitting or replacing these older aircraft. Future fleet composition, new aircraft availability, and total demand for air transportation must be considered at arriving at an acceptable noise policy.

Agency forecasts are also used in assessing the impact on the aviation industry of new FAA safety regulation or proposed legislative initiatives. Given projections of future fleet replacement and growth and fleet utilization, what kind of changes should be made to fleet air worthiness and operation standards? How long will a plane be operating--25 years or 35 years, or 20,000 cycles or 80,000 cycles? Will there be 2,000 planes, 4,000 planes, or 8,000 planes operated by major airlines? With this information, the FAA studies the need for special aircraft fatigue inspection programs, new collision avoidance equipment, and mandatory refurbishing of cabin seats and interiors.

In conclusion, I'd like to say that FAA management really does use agency forecasts extensively, and in my opinion, they are extremely influential in the decisionmaking process.

Forecasts of one type or another are part of the information base underlying most policy decisions made in this town. This is evident whether those forecasts are rough or sophisticated, biased or objective. The what-if question is critical to policymakers who want to know the results of a decision to either create a new policy lever or adjust an existing one. These what-if questions are critical to assessing the probable consequences of a potential policy decision. Thus, forecasts provide an a priori evaluation mechanism which permits policymakers to assess whether the policy change under consideration would produce the desired results.

As a result of their unique contribution to the policy process, forecasters and their forecasts are often viewed from one or more of several perspectives. Forecasters are likely to be the most sought after or the most spurned of analysts. The esteem with which forecasters are held and the enthusiasm for a particular forecast depends on several conditions, including:

- (1) The sensitivity of the events or behavior which is being forecast,
- (2) The diversity of opinion about the issue in question and how strongly those opinions are held,
- (3) The overall reputation of the forecaster (it is more difficult to dismiss a forecast from a reputable source), and
- (4) The divergence of the forecast from the particular position being advanced by the forecast user.

Policymakers want a clear and concise statement of the outcome of future events. Such information is needed early enough in the policy process to guide decisions. While users are often less interested in the conditionality of the forecast, they realize that no one has a crystal ball. Forecasters must use assumptions, conditional variables, historical relationships, and analytical frameworks in their trade. Forecasters are often unimpressed with conditions or variables that cannot be quantified and incorporated into their analytical framework even though these conditions are often important to policymakers and other forecast users.

While differences in perspectives lead to misunderstanding between forecasters and users, the two groups are interdependent. Policymakers need credible forecasts of the probable outcome of an event or policy change even if the forecast does not support a preconceived position. Forecast users may argue that the forecaster did not consider all relevant information. Forecasters, on the other hand, may argue that the variables in

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<sup>6</sup>Associate Administrator, Economic Research Service, U.S. Department of Agriculture at the time of the conference, now Director, Agriculture and Trade Analysis Division, ERS.

question cannot be quantified or may be irrelevant given the forecast methodology. The bottom line is that policymakers and other users need credible forecasts for decisionmaking, and forecasters need such users or there is no market for their wares.

The most critical elements in providing useful forecasts are timeliness, credibility, and communication. Forecasts must be provided to decisionmakers at critical junctures in the decision process to achieve maximum impact. Thus, forecasters must often anticipate user needs and be ready to respond. A forecast provided after decisions have been made will not be well reviewed by decisionmakers, particularly if it does not support the decision. In addition to being timely, forecasts must be credible. Credibility means more than sound methods and reliable databases. It means that appropriate variables and conditions must be considered and assumptions and limitations of the forecasts clearly articulated. Finally, forecasters and users must communicate. Users need to understand the conditions and limitations of the forecasts and forecasters need to understand the positions of users and the information they feel is important to the analysis.

Despite any problems or misunderstandings that may exist between forecasters and forecast users, forecasts remain critical to the policy process and the demand for forecasts will increase as our world becomes more complex. Yet, the job of forecasting will become more difficult, and the challenge of producing credible forecasts more formidable.

### **Forecasting by the Economic Research Service**

Forecasting is an integral part of the Economic Research Service (ERS) program. We would not be a relevant service agency without forecasting. ERS forecasting can be divided into three areas: baseline forecasting, situation and outlook forecasting, and scenario analysis.

#### **Baseline Forecasting**

In the area of baseline forecasting, our purview is the annual performance of the agricultural sector over the next 10 years. We describe the agricultural sector and commodities in terms of production, use, stocks, price, and government program participation and in terms of aggregate receipts, costs, and net income. The agricultural sector influences and is influenced by the nonagricultural part of the domestic economy as well as by international conditions. Therefore, preparation of a baseline requires forecasts of macroeconomic variables such as inflation, interest rates, economic growth, and exchange rates with other currencies. Forecasts of food costs are also provided. Obviously the baseline is a highly conditional forecast. We use it as an internal benchmark. We do not release the baseline as a public product because users do not understand or are unwilling to recognize the conditions that accompany the forecasts.

## Situation and Outlook Forecasting

Our second forecasting area is situation and outlook, with a forecasting horizon of one to five quarters. The purview is commodity markets, input costs and conditions, farm income prospects, and food costs. Situation and outlook rests on a foundation of statistical estimates of acreage, yield, market prices, input costs, and livestock numbers. The statistical estimates are provided by the National Agricultural Statistics Service. Situation and outlook forecasts are publicly available through numerous reports and news releases and are designed to provide the agricultural information that is necessary for the functioning of an open market economy. Situation and outlook forecasts are less conditional than baseline forecasts. Because situation and outlook forecasts are short run, users evaluate the credibility of situation and outlook on the basis of predictability of outcomes that are readily apparent after only short lapses of time.

## Forecasting of Scenarios to Study Issues and Alternatives

A third area involves forecast scenarios of economic conditions under alternatives associated with emerging events (for example, the effect of higher oil prices on food prices), alternative program provisions (for example, changes in program costs if an acreage reserve program requirement is increased by 5 percent), or policy changes (for example, how world trade flows might change under free trade as has been proposed under the GATT negotiations). The policy and program analyses typically require forecasts that look ahead from 1 to 5 years. These forecasts are often highly conditional because of the nature of the alternatives or issues being considered, as well as assumptions that have to be imposed in order to isolate the variables that policymakers or program administrators are focusing upon.

## **Forecasting Methodologies**

As a standard, the most useful and sought-after prediction is one that is unconditional and accurate. Four forecasting methodologies play a role in the ERS forecast areas.

The oldest methodology and the one that has the potential to be most accurate is that provided by the commodity expert. While human expertise is not limited to providing commodity analysis in ERS, our situation and outlook program has a long history and reputation of relying upon commodity experts with a well-honed familiarity with their respective markets. Commodity experts, of course, have access to and use quantitative forecasting tools. These tools, which comprise the other three methodologies, include multiple regression, econometrically based simulation models and optimizing equilibrium models.

Commodity expertise and multiple regression are used most heavily in situation and outlook. The baseline relies on commodity expertise and econometrically based simulation models.

Equilibrium models are commonly used for policy and program analysis focusing on trade.

### **Perspective of Manager**

As I mentioned earlier, the relationships between forecaster and user is often plagued by conflict. Thus, we need to focus on better communication between forecast analysts and forecast users. Forecast analysts tend to present their forecasts on a take-it or leave-it basis and sometimes seem unwilling to consider any conditions or variables beyond what is directly covered by their models or procedures. Forecast users tend to use forecasts without giving consideration to the conditions or assumptions that are a part of a forecast. Users are prone to remember forecasts and compare the forecasts with outcomes but forget how the underlying conditions may have changed and how such changes would affect the forecast.

Related to this conflict is the potential to misuse forecasts. Many users view forecasts as unconditional predictions. In dealing with economic relationships, there is no way a forecast can be made unconditional. Users that view forecasts as unconditional see the whole forecast as either right or wrong, and once a forecast is deemed wrong, it is dismissed as useless. Forecasts can convey much more information than just the numerical forecast so even if a forecast does not accurately predict the future, it may still contain useful information. Another problem that we face as a Government agency is that users sometimes view our forecasts as implying a Department statement. They then expect the Department will use its program authorities to realize the forecasted value. These misuses help explain why we do not publish our baseline.

My perspective as a manager in an economics agency is that forecasting is a vital function that has much to offer and is increasing in importance. A good forecasting program starts with good analysts and the best tools. In addition, there are several other areas that are important. In my view, good forecasting goes hand in hand with a well-managed effort to gather, organize, and maintain databases. Managing data is not a glamorous activity, but it is imperative that it is done and done well. Nor do I see enough self-critique or organized efforts to maintain a track record and find ways to learn from past forecasts that were less than credible.

I wholly support basic work to refine, improve, or discover new forecasting techniques as a necessary complement to the forecasting program. ERS engages in this basic work. But I would issue a caution not to make this kind of work an end in itself. The ultimate end must be providing better forecasting service to improve Government efficiency. That means being on the firing line with credible forecasts focused on the problem at hand and delivering the forecasts when they are needed.

### How Could Forecasts Be Made More Accurate?

I believe we have to put a lot of emphasis on data. That means better data, more data, and better maintenance of data. With the complexities in fast-communicating international markets and the opportunities computer analysis affords, the ability to bring many variables into focus is necessary and possible, and that requires data. Another step that we can take to improve accuracy is to engage in more indepth critique of our forecasts. Analysts need to keep track of their forecasts, compare these forecasts with reality when it becomes available, and then go back and determine where the forecasts diverged from emerging reality. It goes without saying that continued basic work on tools of the trade is also important.

### How Could Forecasts Be Made More Effective?

Here we have to look at the human element. Forecast analysts and forecast users need to work on establishing a better communication interface. The forecast is only the tip of the pyramid of information that has been brought to bear on the forecast. Both parties may overlook additional information that can be conveyed if the user is willing to look at what is behind the forecast and if the forecast analyst is willing to consider information that a user may be able to interject.

### Should Forecasters Be Making Policy Recommendations?

If the answer has to be yes or no, the answer is no. One simplistic way of looking at this question is that analysts are hired to make forecasts while policy decisionmakers have to be elected or appointed. Forecasters should concentrate on getting their thrills by being responsive to policymakers in terms of giving them quick turnaround on their requests for forecasts and by clearly explaining the conditions and role of conditions behind their forecasts. I think forecasters can challenge policymaker views on the basis of objective information which hopefully would engage forecasters and policymakers in relevant dialogue. That is different than making a policy recommendation. Forecasters can also provide additional alternatives that policymakers have not asked for but which the forecasters' analyses may suggest as being relevant. This would give the policymakers more or different information. But, overall, forecasters would generally have a narrower perspective than policymakers and decisionmaking from a narrower view could be as faulty as a decision that ignored forecasted alternatives.

### Are Career Paths in the Federal Government Adequate for Forecasters?

Yes, relative to other job classifications. Forecasters provide a valuable output, and their craft requires a high level of technical skills. In ERS, being a forecaster is a good way to earn recognition and promotions. Just as for other skills, forecasters would have to take on supervisory and management functions to move to the higher grades.

### What Do You See for the Future of Forecasting in the Federal Government?

As the world shrinks from a transportation and communication standpoint and as economies become more interdependent, forecasting becomes more important and more complicated. The challenge is to learn how to best integrate forecasting into policy and program decisionmaking. The two-way communication issue comes up again. Forecasters will have to emerge from the inner sanctum of theoretical purity and symbolic exposition. On the other side, decisionmakers can tap a valuable source of information if they are willing to interact with forecasters and look beyond the one-dimensional point or interval estimate. Forecasting has a bright future. A key will be communication and exposition of forecasts.

Coming before an audience that is primarily Federal employees who work in the domestic sector to talk about forecasting in the Central Intelligence Agency (CIA) may strike you as a somewhat unusual occurrence. But in fact, CIA has throughout its history been involved in a range of forecasting activities that look at foreign developments, in an attempt to put in place for policymakers around town developments that they may want to consider in making critical policy decisions.

The range of forecasts that my colleagues at CIA engage in span from very detailed military studies that attempt to give some insight into the capabilities of some of our adversaries and potential adversaries down to detailed specifications of the kinds of capabilities of weapon systems that might exist.

We jump to economic forecasts for specific regions or countries that bear on things like postures that the President might take at an economic summit. We do a fair amount and growing amount of technological forecasting where we attempt to look at critical technologies that will impact on the United States whether it be on our defense sector, or on the key elements of our economy, and we look at world trends and attempt to suggest where the technology is going and what this might mean in commercialization.

Finally, we do a fair amount of near-term and long-term political forecasting that involves some modeling activities but also some combinations of expert judgments. To do those forecasts, the Agency has relied historically on a range of capabilities, the most complex being large econometric models. We do a lot of trend analysis and trend forecasting in other areas, and increasingly we find a population that is interested in the use of computers--what I like to term the coming of age of the "Donkey Kong" generation. Here, we identify analysts who are willing to sit down and try to embed their ideas in simple computer code to look at the implications of combinations of ideas--what one of my colleagues has referred to as scenario or what-if analysis.

Underneath we're trying to serve really two basic categories of consumers. First, we're trying to look at what the interests of the policymaker are, as explicitly tasked to us, to give him or her some information to help think about a problem. Second, we are trying to get out, based on our expertise, what we think are some issues that ought to be on the agenda--issues that, if we don't raise them, may not get raised.

Included in the list of our customers are the senior officials in the executive branch. Forecasts that we do will go to as few as a half a dozen people, but also audiences as large as 600 in the

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<sup>7</sup>Comptroller, Central Intelligence Agency.

executive branch. For almost everything that we do, we must have in the back of our mind that our forecasts may well make it into the hands of our oversight committees of the Congress. So we must be rather careful that we are not making statements that are frankly scurrilous about others who are part of the process. If our forecasts do their job, they address one or more of the following kinds of things. One, they may give a basic outlook on what we think are trends and developments on a particular problem, or particular region, or particular topic. They are, in effect, our counterpart to the baseline forecasts that have been referred to by an earlier speaker.

Second, if our forecasts are effective, they help structure the debate as policymakers think about the solutions that they can fit in, developing new policy or tinkering with existing policy. Ideally, we help people sort through alternatives by giving them, in effect, a zone where solutions can, in fact, be obtained.

We spend a lot of time worrying about the consistency of the forecasts--the consistency in our internal forecasts, but also to lay out for policymakers consistencies or inconsistencies in forecasts that might be made by a dozen reputable groups about a key economy or a key problem outside the United States. In effect, we sort of try to illustrate the implications of different assumptions that are made by forecasters.

Along the way we've learned some things, as my predecessors on the panel have talked about. The best forecasts from a policymaker perspective are those that are simple and readable, that come to a bottom line, and that permit the policymaker to have some feeling of trust or belief to back up his or her judgments. The best forecasts are those that are delivered in a timely fashion to influence a person's thinking about a problem. The worst forecasts are those that show up 5 days after a policy has been publicly announced that, shall we say, are somewhat inconsistent with the policy.

Finally, the best forecasts and the most useful forecasts, as almost everybody on the panel has said, are those that make clear the uncertainties associated with the forecasts, the alternatives that we considered, and the conditionality of the logic that we are using. I continue to be amazed throughout Washington and elsewhere in the country about how conditional reasoning seems to be something that is foreign to the Western mind. All too frequently, the forecasts will be translated as, "We'll take the implication and forget the conditionality."

Given that orientation, we sometimes face an uncomfortable situation when the forecasts don't quite work out, and we go back and say, "But none of the conditions were met, why would you expect the forecasts to work?" Then to have some reasonable debate along those lines is somewhat difficult.

In closing, my major concerns about the future of forecasters and forecasting inside the Federal Government are basically twofold. Number one, like almost everyone else in this town, I'm concerned

about our ability or inability, given the way that the economy is developing, to recruit people and retain people in the Federal service who are prepared to do this kind of work. As the gap expands between the skills we need and the skills we can actually pay for in certain critical areas, I'm frankly very concerned about how we will keep a stock of people in the future who are able to do this really relatively rare kind of activity.

Second, I'm concerned about our ability to provide the tools that people need. As others on the panel have said, this is an information age. Having the tools (computer tools, software tools) to deal with large amounts of information available and accessible in a modern format is something that is extremely expensive if done correctly, and it is in some sense competing with some of the other dollars that we have to devote to other causes.

Thus, if I could wave a wand, I think I would wave it to provide adequate salaries for people who do this kind of work so I could go out and recruit the people whom I need, and give them an environment that would keep them challenged. One of the ways to keep them challenged is make sure that they always have the very best tools to confront the really hard problems.

## Questions and Answers

**Participant:** Even though some of us call ourselves forecasters, we all have to recognize we're in a political environment. What do you do when the results of your forecast sometimes oppose the political realities that the administrators want? Anybody on the panel can answer that.

**Mr. Robinson:** I don't think there is a magic answer to that question. I think there are two types of questions that I would consider. If the forecast that is being made is normally a published forecast in one of the sources established by agencies, it is going to flow through the system as it goes through its regular review process.

If on the other hand, the forecast is something that has been provided to a policymaker in a timely fashion, as Leo Hazlewood mentioned, it provides useful, and possibly critical, information as the policymaker establishes his or her position. If the forecast arrives after positions have been established, we've got a problem from the outset and there's no solution.

If the forecast arrives in a timely fashion, and the policymaker chooses to make a policy decision that is contrary to the forecast, we still have to remember that, forecasts are not perfect, and the policymaker is considering a broad set of conditions in addition to the forecast. For example, equity issues, efficiency issues, and political goals, are but a few of the criteria considered in making policy decisions. While the forecast might be very useful, it might not be what ultimately determines a policy decision.

I think those are the kinds of issues that forecasters have to keep in mind. The best analysis or the best forecast may not take the day, particularly if it arrives at the wrong time or at an inappropriate juncture in the policy decision process.

**Ms. Wetrogan:** We may not have a similar problem in dealing with the Federal sector, but in doing subnational population projections, we often get calls from State legislators, or executive branches of many States saying, how could you come out with a State population projection like that? Don't you know we are considering certain policies that are going to change all of our past trends, and you've now played havoc with what we want to do?

Our response is that it's a projection. We've tried to make our assumptions very, very clear and, in fact, the best path for you would be to prove our projection wrong. What we are showing you is what will happen if these trends continue, and we're glad to hear that perhaps you're discussing alternatives to alter the future so it won't be like the past.

It's very hard sometimes. Even though you put out all of the conditions on your numbers when you publish them, the numbers go

into a newspaper and private investors look at those numbers and decide where to put their dollars and don't look at all of the conditions.

But again, we step back and say, we are not putting local policies into our projections. We will go by the trends and do a projection based upon what the trends say and try to more carefully specify the conditions.

**Participant:** I've got a question for John Rodgers. You talked eloquently about the detailed variables and factors which go into transportation planning, airport planning. You only spoke about airplanes and airports. How do you, in your planning of aviation, consider alternative transportation modes?

Airplanes are the dominant long-distance mode in the United States. That's not everywhere the case. I just came back from Europe and the only airport congestion I had was in Frankfurt, which is overloaded. But within Europe, I didn't use an airplane and most Europeans don't.

You have high-speed rail which goes sometimes 200 miles an hour on railbeds. What if TJB, the high-speed rail, were to become a reality right now; except for the Metrorail, it isn't. When you plan ahead and you plan to decongest the more populated areas, are you considering alternative modes of mass transit?

**Mr. Rodgers:** The answer is yes. Given whatever information we have on hand about future investment in those alternative modes, we try to factor that into our forecasts, particularly when we are talking about specific forecasts for individual airports.

Of particular concern right now is the forecasting that's being done for the east coast airports, which are very congested and where there is a suggestion that perhaps high-speed rail might, in fact, be a viable alternative mode. We frequently will prepare a primary forecast based on what we think are the most likely set of assumptions. At the same time, we may prepare alternative forecasts based essentially on a different set of assumptions about things that would have to happen or could happen to make a change. That information is made available to our own management and also to the Office of the Secretary of Transportation. The Department of Transportation in the end has the overarching responsibility to try to balance out the various forms of transportation and they do so. Basically, they help formulate our longrun authority--our statutory authority for action.

# **Concurrent Sessions**

## Session A: Modeling and Forecasting Nursing and Physician Personnel<sup>1</sup>

Chair: Herbert Traxler<sup>2</sup>

### Current Modeling of the Nation's Demand for and Supply of Nursing Personnel

Evelyn B. Moses and William A. Losaw<sup>3</sup>

***Abstract.** This paper focuses on the evolution of supply and requirements forecasting techniques within the Division of Nursing, Bureau of Health Professions. The authors discuss supply forecasts, which have evolved from rudimentary differencing techniques applied on a national basis for large aggregates of types of nurses to sophisticated population cohort models addressing State, educational levels, and age categories, and requirements models that use various techniques, such as statistical, simultaneous effects with feedback, econometric, professional judgment, and hybrid models. They also describe the Division of Nursing's current project to design, test, validate, and implement demand-based requirements for the nursing services model.*

The Division of Nursing, Bureau of Health Professions (BHPr), has a longstanding history in developing forecasts of the supply and requirements for nurses, more specifically and mostly, for registered nurses. The methodologies used in the past were fairly crude compared with those used currently. Requirements for more specificity and detail along with the advent and prevalence of computerization has led to more sophisticated approaches. The increased availability of more comprehensive data has also played a part in the development of the more complex approaches being used today. However, before discussing the current approaches, it is informative to examine what occurred earlier in the evolutionary process.

#### A History of Nursing Models

##### Forecasting in the 1950's and 1960's

The Division of Nursing Resources (now the Division of Nursing) in 1948 developed a manual for State planning for nursing resources. The manual presented methodology for determining nursing requirements based on compiling desirable ratios of nursing personnel to the population to be served that could be

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<sup>1</sup>Editor's Note: In order to meet the predetermined space requirements, this presentation has been edited down. See References for further information.

<sup>2</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

<sup>3</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

gathered from a variety of sources(1).<sup>4</sup> Methods also used by the Government during that period to determine national requirements consisted of arraying State nurse-population ratios and selecting a cutoff point (for example, the upper quartile) as the appropriate ratio to achieve in the country(2).

An important milestone in the evolution occurred with the issuance of a report in 1963. That report, Toward Quality in Nursing, Needs and Goals, reflects the findings of a group set up by the Surgeon General to "advise on nursing needs and to identify the appropriate role of the Federal Government in assuring adequate nursing service for our Nation." (3) That report was particularly significant since the data developed in it led to the first comprehensive law providing support for nursing education.

### Impact of P.L. 94-63

In the early 1970's, the Division of Nursing launched several projects to develop new methodologies for projecting the supply of and requirements for nursing personnel. These projects were launched prior to the passage of P.L. 94-63, the Nurse Training Act of 1975. The passage of that law shortly after these efforts were initiated had a major effect on the course of these projects and the use to which the efforts were put. P.L. 94-63 contained a section that required annual reports to the Congress (these have subsequently been changed to biennial reports) including data on the determination of the current and future supply of and requirements for nursing aides, licensed practical or vocational nurses, registered nurses, registered nurses with advanced degrees, and nurse practitioners, within the United States and within each State. In order to satisfy these reporting requirements, some modifications and adaptations were made to these projects. The legislative mandate, therefore, became the framework for the program developed and carried out by the division from that point forward.

### Results of Research in the Mid-1970's--Requirements Models

In the mid-1970's, Vector Research, Inc. was asked to determine the impact of specific systems' changes on national requirements for nurses. The approach they took was to design a base model which provided forecasts of the future requirements based on trends in the population, the services required by the population, and the utilization of registered nurses in providing these services. The impact of the system changes were then developed as changes from the basic trend forecasts developed from this model. To be responsive to P.L. 94-63, the contract was modified to adapt the model to State-by-State forecasts(10,11).

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<sup>4</sup>Underscored numbers in parentheses refer to sources listed in References.

Community Systems Foundation developed a micro model that estimates the demand for nurse manpower in four types of employment settings at the county level by using sets of multiple regression equations. The primary factor in developing forecasts with this model was the availability and reliability of data. The lack of such comprehensive data at the county level, particularly, precluded the maintenance of the model and the production of actual forecasts of requirements.

The Western Interstate Commission on Higher Education developed two requirements models: a systems dynamics model and a State model. The systems dynamics model, developed under a subcontract with Pugh Roberts, Inc., is a national nurse market model which explicitly takes account of the interactions of nurse supply and demand and thus reflects supply-demand feedback in the market for nurses. The model requires a vast amount of data, and the maintenance and updating of such a model would require an extensive amount of support. The State model was developed as a tool for States to use in planning for their future nursing resource requirements. The State model approach has been maintained through subsequent iterations of the reports to Congress.

#### The Models: Currently and in the Near Future

The models the Division maintains are designed to be responsive to the congressionally mandated requirements for data on nursing personnel which call for information for each State and for the country as a whole on all types of nursing personnel, including data on registered nurses with advanced training.

In the latter part of the 1980's, a study done for the Division established that there were essentially no techniques or methodologies available or in practice that could be used by the Division to gain significant improvement in any of the three categories of models--nursing education, the supply of nurse manpower, and the requirements for nurse manpower--at a reasonable cost<sup>(12)</sup>. Therefore, the late 1980's were essentially a period of consolidation where many refinements and revisions were incorporated in the models without having to respond to major changes in reporting requirements. However, in the near future, we again expect to see significant changes in the information objectives of the models to respond to many questions raised by the nursing shortage of the late 1980's.

#### The Education Model

The performance of the nursing education system is the single most dominant force involved in shaping the nurse population and supply. The current period saw the introduction of multivariate models, estimated by regression techniques, that related educational system outputs to not only past performance of the system itself, but also to the changing components of the general population entering schools of nursing. In the case of graduate (and post-RN) education, both the pool of eligible students and system capacity were considered as determining variables.

Different basic programs in nursing were seen to draw upon somewhat different strata of the population, the diploma and baccalaureate schools predominantly admitting the 18- to 24-year-old female age group, while the associate schools also drew significant numbers from the 25- to 44-year-old female age group. Competition from other traditionally female professional occupations such as teaching were also considered as causal variables. The completion rates for the basic programs (ratio of graduations to admissions) were used to determine the number of graduations for each of the three basic programs.

It has become increasingly evident in recent years that a more complex set of determinants are responsible for the changes in the output of the nurse educational system. These determinants generally are properties of the geographic area from which the school draws its student population. Thus, such area characteristics as changes in the capacity of the health care industry, changes in the capacity of the post-secondary educational system, and measures of economic levels all appear to play significant, albeit varying, roles in the changes of the nursing educational system output. An extensive preliminary analysis has demonstrated that most of the variables described above play a significant part in determining the performance of the schools of nursing when the effects of location are considered, allowing for use of a much more complete set of variables, including those describing the socioeconomic environment of the area (13,14).

### The Supply Model

The supply model's output objectives are the estimation of the nurse population, supply and full-time equivalent (FTE) supply by cohorts that are defined by three levels of highest educational attainment, State, and by 5-year age groups. The new reporting requirements necessitated the use of several input variables quantifying the behavior of the nurse population. Some of these are relatively straightforward and have not exhibited significant changes over the recent past, that is, intro- and exo-migration (migration of the nurse population into and out of a State) and mortality. The educational inputs and upgrades are certainly controlling variables that change significantly over time and have been addressed in the previous section. The gain and loss of licenses are considered in three separate flows: (1) gains from newly licensed nurses (derived from the graduations from basic nursing education programs), (2) losses due to mortality, and (3) a net loss (the net of the total number of registered nurses (RN's) renewing none of their licenses and those who obtained licenses after letting all of their licenses lapse).

Currently a model of the behavior of the net loss as a function of age is being implemented. There are no data available that quantifies either the number of relicensed RN's or those who do not renew all of their licenses during a given period. This phenomenon is determined indirectly by calculating how many licensed individuals should be present in the nurse population, given the population at some earlier point in time and by adding

new licenses that have been granted during the intervening period and subtracting the losses due to mortality. The initial estimates of this rate as a function of age showed that the net loss was positive (net loss of licenses) in the early to middle childbearing years, was negative (net gain of licenses) for 10 or 15 years after that period, and then became relatively strongly negative again approaching and during the retirement years. More recently, however, this well-defined loss and gain over the middle career years became less and less well defined as to time of occurrence and less pronounced in terms of order of magnitude. The behavior around the retirement years remained basically the same. This model will be a simple asymptotic extension of the present behavior into the future when the net loss will approach zero in all but the retirement years, and when the net loss will then become a loss simply due to retirement.

After the population values are calculated, the activity rates (the ratio of the employed RN's to the RN population for a cohort) and the FTE-to-RN ratio (combining part- and full-time employed RN's to calculate a full-time equivalent employed number of RN's) are applied to the population levels to obtain the nurse supply and the FTE nurse supply, respectively. The FTE-to-RN ratio has not varied significantly in recent years, but the activity rates have exhibited significant changes due to the forces that affect this predominantly female population, such as age, marital and family status, and the general conditions that affect health care system employment. The activity rate, the fraction of nurses in a cohort who are employed, is also being modeled by the Division.

#### The Requirements Model

The historical trend-based approach (which evolved from the Vector model) is an eclectic modeling approach because of the variety of analytical techniques it employs. This model established relationships based on data that were essentially already in existence, both at the national and State levels. The model also addressed two distinct areas: the amount of health care services provided to the population and the utilization of nurse manpower by the providers of those health care services. This approach uses several submodels to project the provision of health care services and the population using those services. Differential forms of exponentially asymptotic functions were used to model the decline and leveling off of the length of stay in community hospitals for the 1981-1988 period when hospitals were adjusting their modes of service in response to the prospective payment system.

The utilization of nursing services is modeled for each of 14 sectors which represent all areas of the health care system that employ nurses. The analytical approaches employed span the gamut from production functions (nurses employed in physicians' offices) to simultaneous systems (substitutability in hospitals under some specialized conditions) to multivariate regression (education/nurse faculty). The remainder of the sectors are modeled by linear equations in one to three variables usually

determined by regression analyses. The ability to implement this model at the State level, for a number of subsectors representing all areas of the health care system that employ nurses, without incurring unreasonable costs, was the major factor in the decision to continue to maintain and operate this model. The major disadvantage to this approach is that the model cannot produce required levels of education within the total requirements projections.

The Division has expanded the problem definition that was specified for the historical trend-based model to one that will address the employer demand for nursing resources and must therefore attempt to incorporate those causal forces within each sector that influence and determine that demand. Further, the educational preparation of the nurses within each such sector will also be estimated. It is anticipated that a variety of methodologies will, as before, be employed on a most appropriate basis to accommodate the different data availabilities and behavioral characteristics of the different health care sectors. The focus on employer demand and the causes of that demand will require innovative approaches to describe the demand-setting interaction--perhaps extending to the use of expert judgment--while remaining within the pragmatic constraints imposed by data availability.

## Conclusions

The process of modeling the current and future supply of and demand for nursing resources is a dynamic activity responding to a dynamic environment. The Division of Nursing has attempted to keep pace with the reporting responsibilities assigned to it by performing and sponsoring a variety of innovative modeling efforts constrained only by resources and the need to achieve quality results. The future will demand that this approach be maintained, stretched to the limit, and then stretched again in order to adequately respond to the evolving information requirements of today and tomorrow, and the resource limitations that will most likely dominate those efforts.

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# Recent Developments in the Forecasting of Requirements for Physicians by Specialty: The Demographic-Utilization Approach<sup>1</sup>

James M. Cultice<sup>2</sup>

**Abstract.** *The Bureau of Health Professions (BHP) Division of Medicine has expanded the BHP general requirements model to encompass the entire physician services marketplace. As a result of our work, we are able to provide specialty detail and offer what we regard as credible forecasts of utilization-based requirements for primary and nonprimary care physicians. The model developed is a demographic utilization model capable of adjusting for total population growth, changes in demographic composition, trends in per capita utilization, and major departures from trends, such as growth in managed care programs and public health insurance programs.*

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<sup>1</sup>Editor's Note: Presentation not available.

<sup>2</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

# The Needs-Based Approach for Estimating Physician Specialty Personnel Requirements

Jerald Katzoff<sup>1</sup>

**Abstract.** *In the late 1970's, the Graduate Medical Education National Advisory Committee developed a needs-based model for projecting requirements for physician specialties. Using physician specialty delphi panels composed of clinical experts, the model incorporated projections of the incidence and prevalence of illness and disease in the U.S. population as well as patterns of care considered appropriate for effective treatment of sickness and for well-care. The Bureau of Health Professions, in its staff capacity to the Council on Graduate Medical Education, recently contracted for updating the needs-based projections model for six physician specialties.*

In this approach, requirements for physician manpower in the aggregate and by specialty are derived from the amount of health care that should be consumed by the public in order to maintain a healthy population. Standards of care by the specific population are determined by expert opinion, data analysis, or from a combination of professional opinion and empirical data. The amounts and quality of services required to maintain a healthy population are based on information such as health status (that is, the incidence and prevalence of particular disease conditions), medical knowledge, and available technology. Services needed are then converted to the number of physicians required by means of productivity standards or estimates. For projection purposes, health needs are estimated according to assumptions about the future.

The prime characteristic of this approach is that it focuses on the health status of the population and the physician manpower required to attain or maintain good health. Consequently, it can produce a clear picture of what ought to be the current or future state of the health care system and how appropriate numbers of physician manpower by specialty should link to that system. In other words, it's a goal-oriented approach, which produces requirements that can be consistent with recommendations designed to rationalize or improve upon the current service delivery system.

It is a highly flexible methodology. Since it builds from disaggregative, morbidity-specific information and explicitly presents the incidence/prevalence and productivity data on which it is based, it can therefore have specific components of the model challenged, refined, or replaced with other data or estimates. The physician-to-population ratios in the aggregate or by specialty derived from the needs-based approach have traditionally been interpreted as ideal ratios, representing the ideal number of physicians needed to serve the population if all health care conditions needing treatment were actually treated.

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<sup>1</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

## Methodology

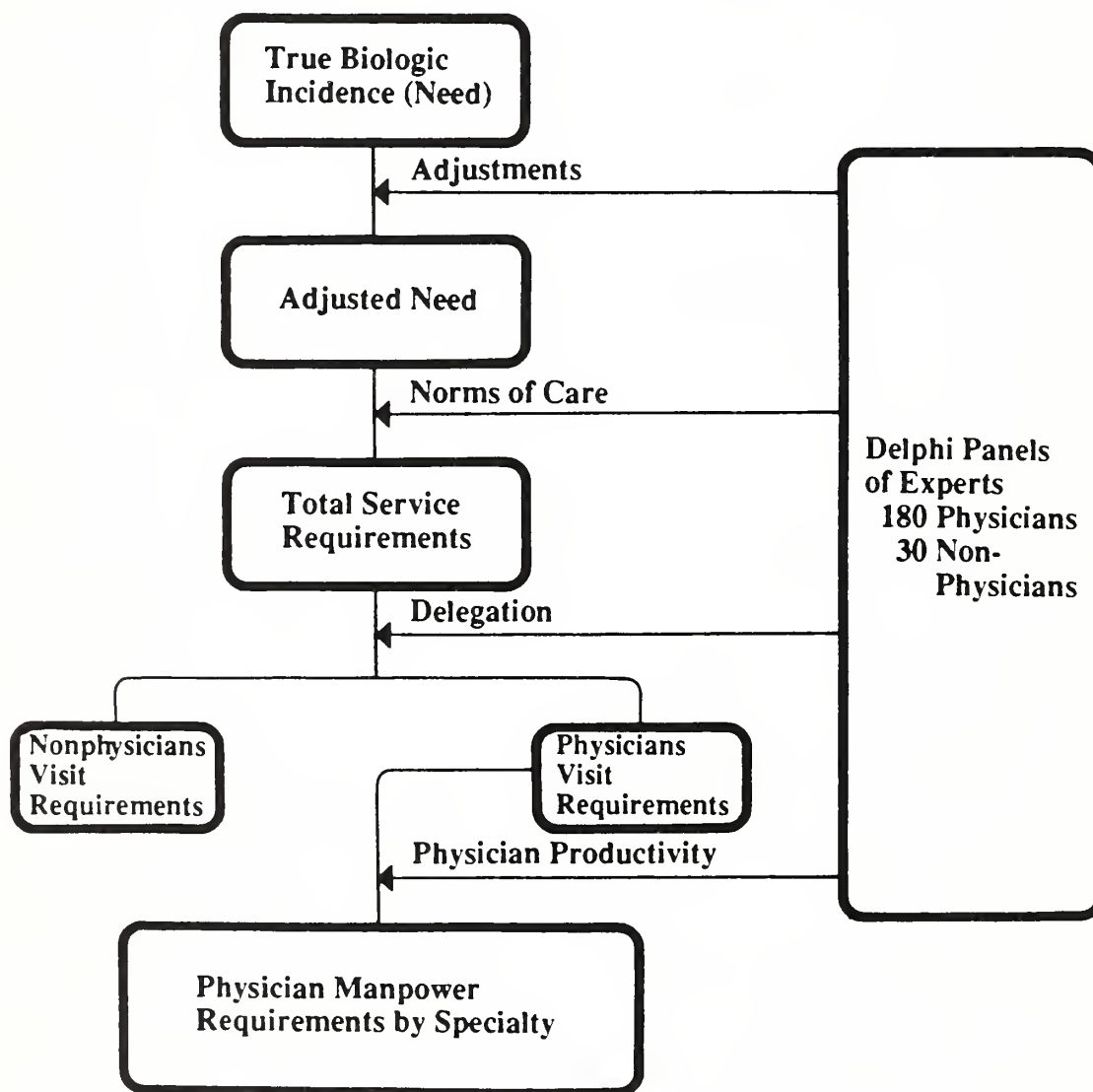
In the late 1970's and early 1980's, this approach achieved its greatest technical advances under the auspices of the Graduate Medical Education National Advisory Committee (GMENAC) and its staff. This committee was created in 1976 by the Secretary of the U.S. Department of Health, Education, and Welfare to advise the Department on appropriate physician manpower policy. It lasted for 4 years. During that time, it developed what it termed an "adjusted needs-based model" for estimating physician specialty requirements. Figure 1 provides the conceptual overview of the model as it was developed and implemented under GMENAC. It's a normative model. The arrows in the diagram can be thought of as decision points for physician specialty panels working on this effort. These panels initially determined the true and projected values for morbidities and the service intensity associated with these morbidities. Basically, they dealt with the incidence and prevalence of disease, adjusted to account for those who need care (that is, not all common colds were thought of as needed to be seen within the medical care system). The specialty delphi panels then estimated the proportion of those that should seek care that should accrue to the specific physician specialty. By linking to this estimate appropriate norms of care, either the number of visits or procedures needed annually for the specific morbidity condition, total service requirements for the entire specialty were developed. Also added in were well-care and preventive care regimens that should be handled by specific physician specialties. By subtracting visits that are delegatable to non-physician staff and providers, and then dividing the sum of the service requirements across all conditions by the productivity of the average physician in the specialty, the physician manpower requirements were calculated for each specialty for 1990.

In this process, the specialty panels reviewed all available data concerning the parameters that they were estimating but ultimately rendered judgment as to what they believed was desirable in 1990. These panels, while specialty-specific, did include members from related specialties. (The obstetrics-gynecology panel, for example, included a family practitioner, nurse midwife, and others). Criteria for composition to these panels included regional representation to some extent and a mix of academic and practice characteristics.

The process did not end there. Subsequently, an independent modeling panel of GMENAC modified and changed many of the parameters to conform to what it considered realistically attainable. The results of this modeling activity produced a set of needs-based requirements projections of the physicians by specialty that, when compared with projections of supply for these specialties, resulted in assessments of specialty oversupply, balance, or undersupply. The work of GMENAC and its conclusions and recommendations received high visibility.

Figure 1

**NEEDS - BASED  
PHYSICIAN REQUIREMENTS MODEL  
OF THE GRADUATE MEDICAL EDUCATION  
NATIONAL ADVISORY COMMITTEE**



In the past year, the needs-based approach for modeling physician specialty requirements has been the subject of new activity. In late 1989, our Bureau contracted with Abt Associates of Cambridge, Massachusetts, to update the needs-requirements model of GMENAC for seven physician specialties: general internal medicine, general pediatrics, obstetrics-gynecology, general surgery, general/family practice, and adult and child psychiatry. The contract is expected to be completed in 1991 and is in support of activities of the Council on Graduate Medical Education.

This council was formed in 1986 to advise the Secretary of DHHS and Congress on appropriate physician manpower policy. It chose to update the GMENAC needs model through the year 2010 as part of its mission to assess the needs of medical and surgical specialties and subspecialties.

As part of the update activity, six specialty panels covering the seven specialties to be modeled convened in person as well as by mail and telephone several times during the year, primarily to help revise and extend the GMENAC modeling work. The panels were presented with briefing books containing all GMENAC delphi panel data, new, updated incidence/prevalence data, and copies of studies and other data sources. Panels prioritized the morbidities for discussion and revised GMENAC parameters.

In the original GMENAC analysis, the standard model was an adjusted needs-based model, in which: (1) actual epidemiological and utilization data were adjusted by experts to reflect their judgment of future trends as well as the percentage of those with morbidities requiring care; and (2) the model was adjusted in that estimates developed by the GMENAC specialty panels were modified to reflect realities of provider and consumer behavior as well as institutional constraints; that is, what was considered realistically attainable. In the current model, update feature number 1 above has been included. However, the needs-based criteria were not adjusted by the realities of consumer and provider behavior. Rather, important trends and factors which might alter the model's projections were incorporated in various sensitivity analyses by specialty. Such trends and factors included the extent of managed care growth and success in eliminating marginally necessary care, extent of delegation in both child and adult care, birth rate and population growth assumptions, assumptions of added visit time for physicians treating indigent children, and assumptions concerning child mental health disease prevalence. These, in part, stemmed from the development of several papers that were developed as part of the contract on issues that may impact on any assessment of supply-needs imbalances. The topics for these papers included the physician manpower impact of: (1) malpractice reform, (2) insurance reform and indigent care, (3) child health and welfare policy, (4) aging of the population, and (5) managed care.

## Preliminary Results

The results below contain summary highlights of the requirements estimates developed to date. They are subject to change and probably will change as certain adjustments have yet to be made to account for allocative shifts in specialty requirements within the adult and child medical care sectors.

Preliminary results would indicate that:

(a) Over 400,000 physicians in the seven studied specialties are required to deal with the health care needs of the U.S. population this year (1990).

(b) This estimate is about 60 percent more physicians than were recommended by the adjusted needs model employed by GMENAC.

(c) The largest variances of the revised requirements against GMENAC occur in the adult and child psychiatric specialties. The update is more than double the required level of GMENAC and includes a richer mix of child psychiatrists.

(d) In large part, the increase in the updated requirements over that of GMENAC reflects the following factors:

- (1) Better incidence data (for example, child mental health);
- (2) No downward adjustments to account for perceptions of what may be realistically attainable (that is, mental health); and
- (3) New procedures (like laparoscopy), new diseases (like Acquired Immuno-Deficiency Syndrome), and new technologies (like endoscopy).

(e) Changes in full-time equivalent patient care physicians between 1990 and 2010 range from a 3-percent decline for general pediatrics and child psychiatry to a 33-percent increase for general surgery.

## Session B: Issues in Employment Projections

Chair: Neal Rosenthal<sup>1</sup>

### An Overview of Bureau of Labor Statistics Projections to the Year 2000

Darrell Patrick Wash<sup>2</sup>

**Abstract.** In 1989, Bureau of Labor Statistics published its latest economic and employment projections to the year 2000. The projections, the Bureau's 17th since 1957, are widely used in studying long-range economic and employment trends and are the basis for the Bureau's occupational outlook program. The latest study finds that labor force growth will slow considerably, and that women's labor force share will increase to over 47 percent. Because of the slowly growing labor force, real gross national product will only average 2.3 percent annual growth and employment 1.2 percent. Service-producing industries, especially retail trade, health services, and business services, will account for almost all of the 18-million-job increase. The occupational structure of employment is projected to change only very slowly, but in general, the fastest growing occupational groups are those requiring higher educational preparation.

Every other year, the Bureau of Labor Statistics (BLS) develops economic and employment projections for the United States, including projections of the labor force, economic growth, industry employment, and occupational employment. This paper presents a summary of the revised projections to the year 2000. Although three alternatives are typically prepared, this paper focuses on the moderate-growth scenario. For more detailed information about these projections, refer to the Monthly Labor Review, November 1989, or Outlook 2000, BLS Bulletin 2352, April 1990.

#### Labor Force

The first step in the projection process is the determination of the future labor force. The labor force, defined as persons working or looking for work, is projected to grow by 19 million persons between 1988 and 2000, from 122 million to 141 million. The rate of growth will slow considerably from the previous 12-year period, from 27 percent to 16 percent. Growth will slow for two reasons, slower population growth and a slowdown in the growth of labor force participation stemming from the decline in birth rates in the 1960's and 1970's. The 16- to 24-year-old labor force will continue to decline, resulting in fewer young workers.

The 25-34 age group, which grew by over 11 million from 1976 to 1988, will drop nearly 4 million between 1988 and 2000,

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<sup>1</sup>Bureau of Labor Statistics, U.S. Department of Labor.

<sup>2</sup>Bureau of Labor Statistics, U.S. Department of Labor.

reflecting the declining birth rates of the 1960's. Almost all of the growth in the labor force will occur among persons 35-54 years of age. This age group will grow by 21.1 million over the projection period, compared with 11.6 million over the 1976-88 period. The 55 and older labor force will grow slightly because of significant growth in the 55-64 age group, which has much higher labor force participation rates than those 65 and older.

Rates of labor force growth are projected to slow for both men and women. As was the case in 1976-88, labor force growth for women will be greater than for men, reflecting women's increasing labor force participation. Women's share of the labor force increased from 40 percent in 1976 to 45 percent in 1988 and the increase is projected to continue, reaching 47 percent in 2000. Women's increasing share of the labor force reflects their growing labor force participation.

Despite widely varying growth rates, the composition of the labor force will change only modestly. For example, young workers' share of the labor force will decline. Workers 16-24 years of age will fall from 19 percent in 1988 to 16 percent by 2000.

Those 25-54 will rise from 69 percent to 72 percent, while workers 55 and over will remain constant. The racial composition of the labor force will barely change, with the white share falling slightly from 86 to 84 percent, the black share rising from 11 to 12 percent, and the share accounted for by Asian and others rising from 3 to 4 percent. The Hispanic share of the labor force also will increase, from 7 to 10 percent.

The number of white workers will grow more slowly than the number of blacks and Asians and others, but whites will have the largest numerical gains. With very rapid growth, Hispanics, most of whom are white, will add over 5 million workers to the labor force and account for 27 percent of the net change from 1988 to 2000.

The total number of labor force entrants will be much greater than net labor force growth because of the large number of people needed to replace workers who will leave the labor force. Between 1988 and 2000, 42.8 million persons will enter the labor force. Of this number, 19.4 million will be due to growth and 23.4 million will be for replacements. White non-Hispanics will account for the majority of entrants, 28.6 million or 67 percent.

### **Economic Outlook**

The second stage in developing the projections is the determination of aggregate economic activity--real gross national product (GNP), labor productivity, the unemployment rate, and the distribution of GNP among the major categories of demand.

GNP will rise 31 percent over the 1988-2000 period, down from 41 percent between 1976 and 1988. In absolute terms, GNP is projected to increase from \$4 trillion to \$5.2 trillion. The slowdown in the rate of growth in GNP is attributable almost entirely to slowing labor force growth.

From 1988 to 2000, the unemployment rate is assumed to remain unchanged at 5.5 percent of the labor force. Productivity is expected to grow at a faster pace during the coming decade, partially offsetting the slower labor force growth. Real disposable personal income (DPI) per capita--the measure of the standard of living--is projected to increase, but at a slower rate, primarily because of the slower projected growth of the labor force and real GNP.

Every major category of GNP will grow. Personal consumption expenditures will continue to account for about two-thirds of GNP. The share of GNP directed to investment will rise only slightly. Improvement in the trade deficit is projected, however. Exports will become a larger share of GNP. In fact, exports will exceed imports in 2000. Government's share of GNP will decline sharply.

### **Industry Employment**

The third phase of the projection process is to develop projections of output, labor productivity, hours, and employment for 226 industries.

Total employment will grow from 118 million to 136 million, or 15 percent. This rate of growth is only half as fast as during the previous 12-year period, reflecting slower labor force growth.

Over time, the distribution of employment among industries changes for many reasons, such as changes in the demand for goods and services caused by changes in consumer tastes, shifts in government priorities, and the effect of technological changes on products and production.

Most of the projected job growth will occur in service-producing industries, which will produce 16.6 million new jobs compared with 0.5 million jobs in goods-producing industries. Construction is the only goods-producing industry division that is projected to grow. Although manufacturing employment is projected to be lower in 2000 than currently, factory production will expand at the same rate as GNP.

Some high-technology manufacturing industries will be among the fastest growing in terms of output. Travel agencies will continue to grow as the number of travelers increases. The gain in oil drilling reflects a rebound from recent very depressed levels.

Although total manufacturing employment will decline, some manufacturing industries are projected to grow faster than the average for the overall economy. Despite rapid growth, these industries--miscellaneous publishing, engineering and scientific instruments, medical instruments and supplies, partitions and fixtures, and plastics products--are relatively small and will generate few new jobs. Declining industries either will face shrinking markets, such as the tobacco industry, or will be able to meet rising demand with fewer workers because of expected

productivity increases, such as telephone and telegraph apparatus, textiles, alcoholic beverages, and office machines.

All service-producing industry divisions are projected to grow; the services and retail trade divisions will account for over two-thirds of the total employment gain. Within the services division, health and business will dominate, accounting for two-thirds of the overall increase in this division. Eating and drinking places will account for two of every five new jobs in retail trade. Most of the expected growth in government will be in State and local education and in protective services.

Half of the fastest growing industries are in health care or business services. The fastest growing health industry will be outpatient services, reflecting a continued shift away from hospitals and toward outpatient treatment facilities. Eight of the 10 most rapidly declining industries are in manufacturing. Most of the industries with rapid declines in employment are projected to post output gains; productivity advances will permit output increases with fewer workers.

The share of the workforce that is self-employed is expected to remain at about 9 percent through 2000. The number of unpaid family workers comprised less than 0.5 percent of total employment in 1988 and is projected to continue to decline.

### **Occupational Employment**

The fourth and final step of the projection process is to develop employment projections for approximately 500 occupations. Faster-than-average growth is projected for the three major occupational groups with the highest levels of educational attainment--managers, professional specialty occupations, and technicians. Of the other major groups, only service workers and sales workers are projected to have faster-than-average growth.

Growth rates of detailed occupations range from an increase of 75 percent for paralegal personnel to a decline of 44 percent for electrical and electronic equipment assemblers. Five of the eight fastest growing occupations are health related, reflecting the expected rapid growth of the health services industry. Medical secretaries, although not considered a health service occupation, will also benefit.

Fast-growing occupations generally require higher levels of education. For example, 8 of the 10 fastest growing occupations generally requiring at least a bachelor's degree are professional specialty occupations; three of these are health related. Nine of the ten fastest growing occupations generally requiring substantial training after high school but less than a college degree are health-related occupations. Five of these are among the fastest growing in the entire economy.

Five of the 10 fastest growing occupations requiring no more than a high school diploma are personal or protective service occupations. Job growth may be expressed in either percentage

terms or in terms of employment change. Occupations with the fastest growth do not necessarily provide the most new jobs. Although employment of retail sales workers is projected to grow less than one-third as fast as medical assistants, it will generate seven times more new jobs. In general, fast growth is an indicator of favorable job opportunities, but large numbers of new jobs also provide favorable job opportunities.

Because of the need to replace workers who leave the labor force or transfer to other occupations, size is a major factor in the number of openings in an occupation. As a result, the occupations that are projected to generate the most job openings are large--retail salespersons, registered nurses, janitors and cleaners, waiters and waitresses, and general managers. In addition, none of the occupations creating the most jobs are among the fastest growing.

Workers who are concentrated in declining industries are subject to displacement. Farmers, farmworkers, and sewing machine operators are examples of such occupations. In addition, other workers--several types of assemblers; hand packers and packagers; typists and word processors; inspectors, testers, and graders; and stenographers--are subject to displacement resulting from technological change.

Three of the four fastest growing groups have the highest proportions of college-educated workers--technicians, professional specialty occupations, and managers. The two slowest growing major groups have the highest proportions of workers with less than a high school education--fabricators and laborers and agriculture, forestry, and fishery workers. Service workers, with rapid growth but low educational attainment, are the exception.

Black and Hispanic workers have lower educational attainment than whites. Hispanic workers have the highest proportion of workers with less than a high school education.

Blacks and Hispanics are underrepresented in the fast-growing and higher-paying managerial, professional specialty, and technician jobs. Blacks are concentrated in three major occupational groups: service occupations, administrative support occupations (including clerical), and fabricators and laborers. Hispanics are concentrated in service occupations, in fabricator and laborer occupations, and in farm occupations. All of the major occupational groups in which minorities are found in large numbers had below-average annual earnings in 1988, and, of these, only service workers are projected to grow faster than average.

## Entrants Versus Net Change: A Minicontroversy

Howard N Fullerton, Jr.<sup>1</sup>

**Abstract.** *The concepts of entrants versus net change are compared for the labor force. The uses of the entrant concept for human resource planning is discussed, with Bureau of Labor Statistics (BLS) data. BLS projects that 43 million workers will enter the labor force over the 1988-2000 period, while the labor force will grow by only 19 million. The sex-race composition of entrants differs from that of net change. Possible applications for occupational employment are considered.*

Many of you have heard that 85 percent of the new entrants to the labor force over the next decade will be women and minorities (including immigrants). Or, put the other way, only 15 percent of the entrants will be native white men. You may have wondered at the source of this statement and what happened to all the native white men. In this paper, I will discuss various measures of labor force entry and change. There are specific and nonobvious meanings to the words "net" and "new." Further, to add an additional element of confusion, there are three sets of such numbers. In 1987, the Bureau of Labor Statistics (BLS) released a new set of labor force projections from 1986 to 2000.<sup>2</sup> Then, the Hudson Institute released a study contracted by the Department of Labor's Employment and Training Administration that had a different labor force projection, with a base year of 1985.<sup>3</sup> In January 1988, in an attempt to clarify what had become a confusing issue, BLS released a table showing entrants to the labor force between 1986 and 2000, based on our 1987 projection.<sup>4</sup> Finally, BLS published in late 1989 a revised projection to 2000, using 1988 as the takeoff year.<sup>5</sup>

There are then three sets of figures and two concepts. The net change concept compares the net change of a specific sex, race, or ethnic group with the net change of the overall labor force. The Hudson Institute erroneously identified this measure in Workforce 2000 as net entrant, and many have referred to it as entrant. It is neither. BLS measures entrants by comparing a

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<sup>1</sup>Bureau of Labor Statistics, U.S. Department of Labor.

<sup>2</sup>Howard N Fullerton, Jr., "Labor Force Projections: 1986 to 2000," Monthly Labor Review. September 1987, pp. 19-39.

<sup>3</sup>William B. Johnston and Arnold E. Packer. Workforce 2000: Work and Workers for the Twenty-First Century. Indianapolis, IN, June 1987.

<sup>4</sup>"Labor Month in Review," Monthly Labor Review. January 1988, p. 2.

<sup>5</sup>Howard N Fullerton, Jr. "New Labor Force Projections, Spanning 1988 to 2000," Monthly Labor Review. November 1988, pp. 3-12.

specific sex-race birth cohort in 2000 with itself in the base year (1986 or 1988). Thus, in 2000, none of those under 28 could have been in the labor force in 1988, so all 16 to 27 year-olds, by definition, must have entered the labor force between 1988 and 2000. Older cohorts are examined and compared with their labor force size in the takeoff year. This is done by sex and by race and Hispanic origin. We can also look at those older cohorts who had more members in the labor force in 1988 than in 2000. This difference we term "labor force leavers." The difference between the entrants and leavers is the net change and should equal the net change calculated by comparing the labor force numbers in the 2 years, for example 1988 and 2000.

We have found it difficult to explain clearly the entrant concept to the public. However, we are continuing our effort. Whenever we find printed accounts making an inappropriate use of the measures, we write to editors or reporters. The exchanges of opinions with these people will, we hope, in the longer run, result in our being able to present the concepts more clearly and thus reduce improper use.

### **Recent Numbers and How They Changed**

The most recent projections (1989) prepared at the Bureau of Labor Statistics show white, non-Hispanic men comprising 32 percent of entrants, while women and minorities would obviously comprise the remaining 68 percent of entrants. In total, there are projected to be 42.8 million labor force entrants 1988-2000. It is from this group, and not from net change, that recruiters will hire over this period.

Recruiters will be hiring replacements for some 23.4 million persons projected to be leaving the workforce over the 1988-2000 period as well as for the expected 19.5 million growth in the labor force over the same period. Because white non-Hispanic men are projected to be disproportionately represented in the group leaving the labor force over the 1988-2000 period (48 percent), their share of net growth, as a result, is only 12 percent. The 12-percent figure is close to the Hudson Institute's earlier projection of 15 percent. These measures, of course, are not close to 32 percent, which is this group's share of entrants and is a totally inaccurate measure of their share of new entrants.

Women are projected to comprise 51 percent of entrants, roughly their share of the population, but are expected to be only 43 percent of those leaving the labor force. Thus, they are projected to account for 62 percent of net change in the labor force in 1988-2000. It is easy to understand why white, non-Hispanic men are such a large share of labor force leavers, since 35 to 40 years ago, the labor force was much more likely to be from this group.

### **Net Change**

Computing shares of net change seems easy: first, calculate the net change in the labor force, then calculate the net change for

the group. Finally, calculate the ratio. However, there are problems. The numbers of entrants can be only positive. The number of leavers could be considered as being only negative. However, net change can be either positive or negative. Thus, we could have a negative share of net change.

### **Some Ridiculous Examples**

To be specific, the number of 16-24 year olds in the 1988 labor force was 800,000 less than in 1976. Thus although these are the ages of labor force entry, young people accounted for -3 percent of net labor force change. It is difficult to think of the labor force growing by 26.6 million while having negative entrants to the labor force at the entry ages.

We may pursue this further. The labor force aged 35-54 is projected to grow by 17 million between 1988 and 2000, 89 percent of net change. Again, it is difficult to believe that the bulk of entrants to the labor force will be people aged 35 to 54. Given that the 55 and older labor force is projected to grow by 2.3 million and the labor force is only growing by 19.5 million, we can see that all the entrants or net entrants will be over the age of 34.

### **Entrants and Leavers**

We have trouble presenting the concept of entrant and of leaver. Although part of the problem may be that the figure is not as spectacular as those generated by the net change concept, it is also true that some find it difficult to understand, even though we are asked how many people will enter the labor force. Currently, we define entrants in presentations as "those in the labor force in 2000 who were not in the labor force in 1988." We can also describe leavers as "those in the labor force in 1988 who are projected not to be in the labor force in 2000." This seems to be helpful, though the strict statistician or demographer will note that we are talking about groups and not individuals.

### **Further Research**

Entrants to and leavers from occupations and industries' entrants and leavers have been a useful concept. For many human resource planners, the question has been: how many job openings, not by how many jobs will the occupation or industry grow? If there is significant turnover, even if employment does not grow, there will be job opportunities. BLS is exploring calculating leavers for some major industries and occupations. It is clear that sample data will not permit projections of leaver data for all the occupations BLS projects. However, having an idea of the number of job openings likely to occur would be useful.

## Entrants As a Projection Methodology

As of now, we project the size of the labor force and calculate the number of entrants. A cohort approach to projecting the labor force would be to project the entrants and leavers and calculate the size of the labor force. This has not been tried, but is an obvious area for future research.

Table 1--Projected entrants, moderate growth scenario, 1988-2000

Group	<u>Thousands</u>	<u>Percent</u>
Total	42,832	100.0
Men	20,735	48.4
Women	22,097	51.6
White, non-Hispanic	28,597	66.8
Men	13,522	31.6
Women	15,075	35.2
Black	5,385	12.6
Men	2,423	5.7
Women	2,962	6.9
Asian and other	2,364	5.5
Men	1,232	2.9
Women	1,132	2.6
Hispanic	6,486	15.1
Men	3,558	8.3
Women	2,928	6.8

Table 2--Projected leavers, moderate growth scenario, 1988-2000

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Group	<u>Thousands</u>	<u>Percent</u>
Total	23,371	100.0
Men	13,341	57.1
Women	10,030	42.9
White, non-Hispanic	19,393	83.0
Men	11,257	48.2
Women	8,136	34.8
Black	2,329	10.0
Men	1,121	4.8
Women	1,208	5.2
Asian and other	504	2.2
Men	282	1.2
Women	222	.9
Hispanic	1,145	4.9
Men	681	2.9
Women	464	2.0

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Table 3--Projected net change, moderate growth scenario, 1988-2000

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Group	<u>Thousands</u>	<u>Percent</u>
Total	19,461	100.0
Men	7,394	38.0
Women	12,067	62.0
White, non-Hispanic	9,204	47.3
Men	2,265	11.6
Women	6,939	35.7
Black	3,056	15.7
Men	1,302	6.7
Women	1,754	9.0
Asian and other	1,860	9.6
Men	950	4.9
Women	910	4.7
Hispanic	5,341	27.4
Men	2,877	14.8
Women	2,464	12.7

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## **The Consistency Problem: Ensuring Accuracy and Agreement Among All Levels of a Complex Projections Environment**

Norman C. Saunders<sup>1</sup>

**Abstract.** *The Bureau of Labor Statistics prepares projections at both an aggregate level of detail and for highly disaggregated industry, commodity, and occupational categories using a disparate array of methods and models. The methodology is discussed in some detail with special emphasis on the techniques used for ensuring consistency at all levels of disaggregation. The approaches allow a staff with widely varying backgrounds, from strict macroeconomic to narrowly focused microeconomic, to effectively interact to produce a unified set of national-level projections for the U.S. economy.*

Projecting employment in industry and occupational detail requires an integrated projection of the total economy and its various sectors. The Bureau of Labor Statistics (BLS) projections are developed in a series of six steps, each of which is based on separate projection procedures and models, and various related assumptions. These six steps, or analytical phases, are: (1) labor force, (2) aggregate economy, (3) final demand [gross national product (GNP)] by sector and product, (4) interindustry relationships (input-output), (5) industry output and employment, and (6) occupational employment (see fig. 1). These steps provide the sequenced, analytical framework needed to develop employment projections. The remainder of this presentation will focus on the methodologies and assumptions used at each stage of the BLS projections process followed by a look at the techniques used to ensure consistency among all levels of this highly detailed set of national-level projections.

### **Labor Force**

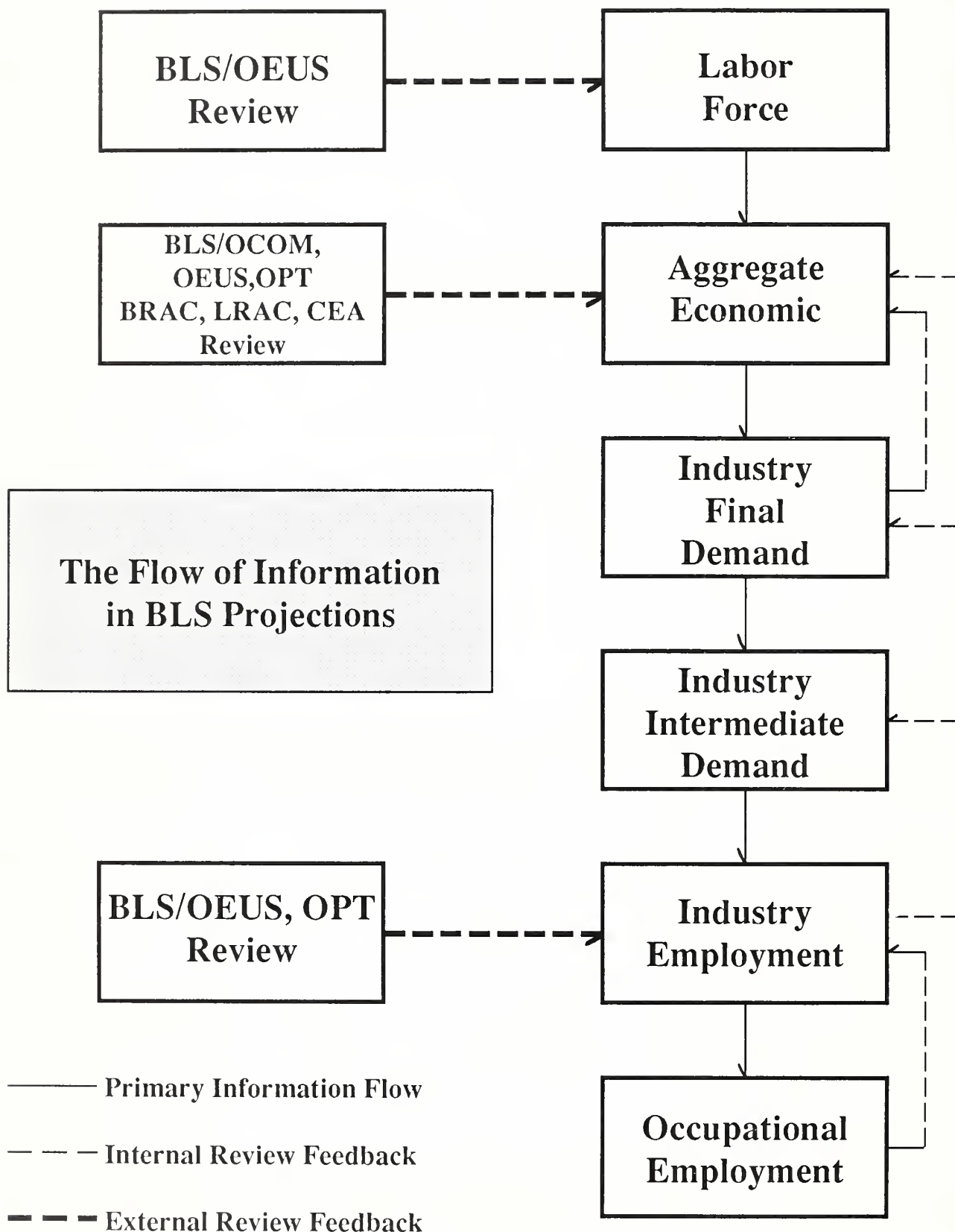
The labor force projections, the first step in the BLS projections sequence, are determined by projections of the future age, sex, and racial composition of the population and by trends in the labor force participation rates--the percent of the specified group in the population who will be working or seeking work. The population projections, prepared by the U.S. Bureau of the Census, are based on trends in birth rates, death rates, and net migration. With the population projections in hand, BLS analyzes and projects changes in labor force participation rates for 100 age, sex, and race or Hispanic-origin groups.

The labor force participation rate projection for each group is developed by first selecting a trend rate of change based on participation rate behavior during the 1982-88 period. Second, the rate is modified when the time series projections for the specific group appear inconsistent with the results of

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<sup>1</sup>Bureau of Labor Statistics, U.S. Department of Labor. This paper was presented at the conference by Neal Rosenthal.

Figure 1



cross-sectional and cohort analyses. This second step ensures consistency in the projections across the various groups. Finally, the size of the anticipated labor force is calculated by multiplying the labor force participation rates by the population projections. The results are again reviewed for consistency.

Although the BLS labor force projections tend to stand on their own as an independent product, the aggregate labor force level is used at the next stage of the projections in order to provide a consistent measure of aggregate labor supply.

### **Aggregate Economy**

Aggregate economic performance--the second phase of the BLS projections process--develops projections of the GNP and major categories of demand and income. These results provide control totals that are consistent with each other and with the various assumptions and conditions of the projections scenarios. The values generated for each demand sector and subsector are then used in the next phase in developing detailed purchases for personal consumption, business investment, foreign trade, and government.

These projections are accomplished using a macroeconomic model. The model basically consists of sets of equations that correlate various aspects of the economy with each other. It provides internally consistent, moderately detailed projections for each set of assumptions and goals. The Outlook 2000 projections were based upon a long-term macro model developed by Data Resources, Inc. This model has approximately 400 equations which determine those factors affecting growth in the U.S. economy. The model is driven by a set of 213 exogenous variables, or values, which are specified by BLS. To provide a range of estimates, the macro model is solved for three economic scenarios representing low-, moderate-, and high-growth possibilities.

Key assumptions fall into three major categories: (1) fiscal and monetary policy levers; (2) demographic measures; and (3) factors affecting energy supply and demand. Key results passed along to later stages of the projections process include the level and demand distribution of GNP, aggregate employment, various income components, and variables reflecting the impact of the business cycle, such as the unemployment rate and the rate of growth of labor productivity.

### **Final Demand**

The BLS projection procedure then moves from the aggregate to the industrial level. For the industry output projections, the economy is disaggregated into 226 producing sectors that cover the U.S. industrial structure, both public and private. The framework for this procedure is an input-output model. The initial input-output data used by BLS are prepared by the Bureau of Economic Analysis, U.S. Department of Commerce.

The development of projections of industry output begins with aggregate demand projections from the Data Resources model. In this model, projections are made for 7 major categories of consumption, 6 categories of investment, 13 end-use categories of foreign trade, and 3 categories of government spending. A further disaggregation of the values from the model is then undertaken. For example, personal consumption expenditures are estimated for 82 detailed product categories. Investment is disaggregated into 58 categories of plant, equipment, and inventory spending. Federal Government purchases are broken into 13 functional categories. State and local government spending is disaggregated into 19 functional categories. The techniques of disaggregation range from detailed econometric models to simple extrapolations of historical trends.

Furthermore, to develop industry output projections, provision is made to allow for shifts in the commodity makeup of a given demand category. This is accomplished by projecting bridge tables relating individual types of demand to the actual industries supplying the goods. The bridge table is a percent distribution for each given demand category, such as the personal consumption or investment category, among each of the 226 sectors in the BLS input-output model. In projecting changes in these bridge tables, expected changes in technology, consumer tastes or buying patterns, the commodity pattern of exports and imports, the future composition of business investment, and other structural factors are considered.

### **Interindustry Relationships**

The next stage in the projections process is the estimation of the intermediate flows of goods and services required to produce the projected GNP. Only final sales are counted in the GNP to avoid repeated counting of intermediate inputs. An industry's total employment depends on its total output whether that output is consumed as an intermediate input or used as a final good. This is accomplished using an interindustry or input-output model. This model mathematically solves for all levels of intermediate inputs given industry input relationships and final demand.

The BLS input-output model consists of five matrices or tables of requirements. The principal table is the "use" table. This table shows the purchase of commodities by each industry as inputs into its production process. In projecting this table, one must take into account the changes in the input pattern or the way in which goods or services are produced by each industry. In general, two types of changes in these input patterns are made in developing a future input-output table: (a) those made to the inputs of a specific industry (as, for example, the changes in inputs in the publishing industry); and, (b) those made to the inputs of a specific commodity in all or most industries (as, for example, increased use of business services across a wide spectrum of industries). The "make" table shows the commodity output of each industry. It allocates commodity output to the industry to which it is primary and to all other industries where

the commodity is produced as a secondary product. The use table is the basis for the "direct requirements" table of coefficients showing the inputs required to produce one dollar of that industry's output. The make table is used to create a "market shares" table, which shows the values of the make table as coefficients. Finally, the "total requirements" table shows the direct and indirect requirements to produce a dollar's worth of final demand. Projected tables are based on historical tables and on studies of specific industries conducted internally or by other organizations both within and outside of government.

Combining the projected total requirements table with the commodity-distributed GNP yields the estimate of total output by each of 226 producing industries, the key item passed along to the industry employment step of the projections.

### **Industry Employment**

The projected changes in industry employment are computed based on the projected changes in output and other factors. BLS uses a regression model containing an equation for each industry to estimate worker hours as a function of the industry's output and the relative cost of labor compared with the costs of other inputs. Other variables are added to some of the equations, such as manufacturing capacity utilization, a time trend, output per hour in the nonfarm business sector, and a technology variable. For each industry, worker hours are converted into jobs using trends in average annual hours for that industry. In order to balance total employment from the aggregate projections with the sum of employment from the detailed regression equations, a number of iterations of the process are necessary.

### **Occupational Demand**

The model used to develop the occupational employment projections is an industry-occupation matrix showing the distribution of employment for 258 industries and for more than 491 detailed occupations. Occupational staffing patterns for the industries are based on data collected by State employment security agencies and analyzed by BLS.

Staffing patterns of industries in the base-year industry-occupation matrix are projected to the target year to account for changes expected to occur in technology, shifts in product mix, and other factors. The changes introduced into the input-output model for expected technological change, as an example, may also change future staffing patterns in industries using the new technology. (For example, one would expect greater employment of computer specialists as computer technology spreads across industries.) The projected industry employment data are applied to the projected industry occupational staffing patterns, yielding employment by occupation for each industry. This is aggregated across all industries to yield total occupational employment for the projected year.

## Final Review and Consistency Checks

As should be obvious from the foregoing discussion, BLS projections are developed, at least initially, from a top-down approach: from a highly aggregated and tightly structured look at the overall economy to estimates of detailed and quite disaggregated sectors of the producing economy and the structure of employment necessary to run that economy. The temptation, of course, is to rely most heavily on the aggregate projections, that portion of the BLS work which is perhaps the easiest to grasp in its entirety, and to calibrate the more detailed phases of the work so that they add up to the aggregate level of detail. This would certainly be the most efficient approach to ensuring consistency but would also, in the BLS' opinion, constitute a tremendous waste of resources. Those staff analysts who prepare the detailed estimates of final and intermediate demand and industry and occupational employment, as well as those staff members of other offices within BLS who spend significant amounts of time reviewing the detailed projections, have all developed high levels of expertise in very narrowly focused areas of the economy, an expertise which quite often implies different results than one would get by simply scaling the aggregate projection controls.

So, to ensure the internal consistency of this large structure, the BLS projection procedure encompasses detailed review and analysis of the results at each stage for reasonableness and for consistency with the results from other stages of the BLS projections. In addition to this comprehensive internal review and modification, the BLS projections are subject to a significant amount of external review. The labor force projections, aggregate economic projections, and industry employment projections are reviewed extensively by the Office of Employment and Unemployment Statistics (BLS). The aggregate economic projections are also reviewed carefully by the Office of the Commissioner, staff members of the Council of Economic Advisors, and two BLS external oversight groups, the Business and Labor Research Advisory Councils. Finally, the implicit industry-level labor productivity estimates are reviewed in the Office of Productivity and Technology (BLS). In short, the final results reflect innumerable interactions among staff analysts and others external to the BLS who focus on particular variables in the model. Because of this review, the BLS projection process converges to an internally consistent set of employment projections across a substantial number of industries and occupations, a convergence which fully accommodates all levels of the experience brought to bear on the projections.

The projection process at the Bureau of Labor Statistics does not end with the development and publication of a set of projections. Once the target year is reached, BLS evaluates the projections to determine what changes in assumptions or models would have made them more accurate. Knowing the sources of errors helps improve the projection process. It also highlights for users the imprecise nature of making statements about future economic conditions, industrial activity, or employment growth.

## Session C: Forecasting Techniques

Chair: Charles Hallahan<sup>1</sup>

### Forecasting With Stochastic Coefficient Models<sup>2</sup>

Charles Hallahan

**Abstract.** *The assumption that the coefficients in a regression model will be fixed constants may not be true for a number of reasons. Coefficient variation can be caused by omitted variables, aggregation over micro units, incorrect functional form, or the dynamic properties of the optimizing behavior of economic agents. This presentation discusses a very general stochastic coefficient model developed by Swamy and Tinsley. Their model includes many familiar models as special cases. The generality of this model may help in producing forecasts.*

"The coefficients arrived at are apparently assumed to be constant for 10 years or for a larger period. Yet, surely we know that they are not constant. There is no reason at all why they should not be different every year."

- John Maynard Keynes, 1938.

"...the capacity of econometric theorists to "invent" new varieties of models with continuous parameter variation tends to exceed the willingness and sometimes even the computational ability of researchers to apply them to real-world situations."

- J. Johnston, 1984.

The above two quotes reflect both the recognition over 50 years ago that the assumption of fixed coefficients may not be universally valid and the response by econometricians since then to consider more general models.

The classical linear regression (CLR) model is:

$$y_t = \beta_0 + \underline{x}_t' \underline{\beta} + e_t, \quad e_t \sim (0, \sigma^2) \quad (1)$$

where  $\beta_0, \beta_1, \dots, \beta_{k-1}$  are fixed unknown parameters.

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<sup>1</sup>Economic Research Service, U.S. Department of Agriculture.

<sup>2</sup>Editor's Note: The text for this presentation was adapted by the author from a series of briefing slides.

Several reasons have been proposed as to why parameters may be expected to vary in such a model.

- specification error
  - omitted variables
  - use of proxy variables
  - incorrect functional form
- structural shifts (war, strikes)
- aggregation over micro units
- dynamic optimizing behavior (Lucas critique)

If  $\beta_{0t} = \beta_0 + e_t$  in equation 1, then the CLR can be rewritten as

$$y_t = \beta_{0t} + \underline{x}_t' \underline{\beta} \quad , \quad \beta_{0t} \sim (\beta_0, \sigma^2) \quad (2)$$

which can be interpreted as a model with a random intercept and fixed slopes.

Another common time series regression model is the CLR with serially correlated error terms.

$$y_t = \beta_0 + \underline{x}_t' \underline{\beta} + e_t \quad , \quad e_t = \rho e_{t-1} + u_t \quad (3)$$

$$u_t \sim (0, \delta^2)$$

$$\rho = E(e_t e_{t-1})$$

Defining  $\beta_{0t} = \beta_0 + e_t$ , we have

$$\beta_{0t} - \beta_0 = \rho(\beta_{0t-1} - \beta_0) + u_t \quad (4)$$

Thus, equation 3 can be interpreted as a fixed-coefficient model whose intercept,  $\beta_{0t}$ , follows an autoregressive process of order 1.

Many econometric texts now discuss stochastic coefficient models.

1. Amemiya, T. (1980) Advanced Econometrics. 181-227, Harvard U. Press.
2. Chow, G. (1983) Econometrics. 320-350, McGraw-Hill.

3. Fomby, T., R.C. Hill, and S. Johnson. (1984) Advanced Econometric Methods. 307-323, Springer-Verlag.
4. Hsiao, C. (1986) Analysis of Panel Data. 181-227, Cambridge University Press.
5. Johnston, J. (1984) Econometric Methods. 407-418, McGraw-Hill.
6. Judge, G., W.E. Griffith, R.C. Hill, H. Lutkepohl, and T.C. Lee. (1985) The Theory and Practice of Econometrics, 515-560 and 797-821, Wiley.
7. Maddala, G.S. (1977) Econometrics. 390-404, McGraw-Hill.

A couple of recent general references are:

8. Chow G. (1984) "Random and Changing Coefficient Models," Handbook of Econometrics. Volume II, (1984) Chapter 21, North-Holland.
9. Nicholls, D.F., and A.R. Pagan. (1985) "Varying Coefficient Regression," Handbook of Statistics, Volume 5, (1985) 413-449, North-Holland.

Stochastic coefficient models have been developed in a number of different contexts. Some examples appear below.

### Cross-sectional Data

- o Hildreth-Houck model (1968)

$$y_i = x_i' \beta_i, \quad i = 1, N$$

$$\beta_i = \gamma + v_i, \quad E(v_i) = 0$$

$$E(v_i v_j') = \delta_{ij} \Sigma$$

$$y_i = x_i' \gamma + x_i' v_i = x_i' \gamma + e_i$$

$$E(e_i^2) = x_i' \Sigma x_i$$

Use generalized least squares to estimate  $\hat{\gamma}$

best linear unbiased predictor of  $\beta_i$  is  $\hat{\beta}_i$ :

$$\hat{\beta}_i = \hat{\gamma} + \Sigma x_i (x_i' \Sigma x_i)^{-1} (y_i - x_i' \hat{\gamma})$$

Need to estimate  $\Sigma$  (positive semidefinite)

## Panel Data

- o Swamy random coefficient regression (RCR) model (1971)

$$y_{it} = \alpha + \underline{x}_{it}' \underline{\beta} + e_{it} \quad , \quad i = 1, N \quad t = 1, T$$

if  $e_{it} = \alpha_i + u_{it}$  cross-sectional effect

$\alpha_i$  fixed  $\Rightarrow$  least squares with dummy variables  
(or one-way fixed effects model)

$\alpha_i$  random  $\Rightarrow$  one-way random effects model  
(also error components or variance components model)

$e_{it} = \alpha_i + \gamma_t + u_{it} \Rightarrow$  two-way models

Generalizing one-way random effects model to allow for random  $\beta$ 's  $\rightarrow$  Swamy's RCR model

$$y_i = X_i \underline{\beta}_i + \underline{u}_i \quad , \quad i = 1, N$$

$\underline{u}_i$  and  $y_i$  are  $T \times 1$  and  $X_i$  is  $T \times K$ .

$y_i$  represents the  $T$  observations for unit  $i$ .

$$E(\underline{u}_i) = \underline{0}, \quad E(\underline{u}_i \underline{u}_i') = \sigma_{ii} I_T$$

$$\underline{\beta}_i \text{'s are iid, } E(\underline{\beta}_i) = \underline{\beta}, \quad E(\underline{\beta}_i - \underline{\beta})(\underline{\beta}_i - \underline{\beta})' = \Omega$$

Writing  $\underline{\beta}_i = \underline{\beta} + \underline{v}_i$  ,  $\underline{v}_i \sim (\underline{0}, \Omega)$ , leads to

$$y_i = X_i \underline{\beta} + X_i \underline{v}_i + \underline{u}_i = X_i \underline{\beta} + \underline{w}_i$$

$$E(\underline{w}_i \underline{w}_i') = X_i \Omega X_i' + \sigma_{ii} I_T$$

Thus, Swamy's RCR model becomes a fixed-coefficient model with heteroskedastic error term.

The parameters to be estimated are  $\Omega$ ,  $\sigma_{11}$ ,  $\dots$ ,  $\sigma_{NN}$  and  $\underline{\beta}$ .

The estimation procedure needs to ensure that  $\hat{\Omega}$  is positive semidefinite.

Swamy derives a homogeneity statistic to test

$$H_0: \underline{\beta}_1 = \dots = \underline{\beta}_N = \underline{\beta}$$

The RCR model can be generalized to allow for serial correlation within each cross-section and contemporaneous correlation between cross-sections.

## Time Series Data

### o Cooley-Prescott model (1976)

$$y_t = \underline{x}_t' \underline{\beta}_t, \quad t = 1, T$$

$$\underline{\beta}_t = \underline{\beta}_t^P + \underline{u}_t$$

$$\underline{\beta}_t^P = \underline{\beta}_{t-1}^P + \underline{v}_t \quad (\text{random walk})$$

$\underline{\beta}_t^P$  is called the permanent component.

$\underline{u}_t$  is called the transitory component.

Note that  $\underline{\beta}_t$  is assumed to be nonstationary.

$$\underline{u}_t \sim N(\underline{0}, U) \quad , \quad \underline{v}_t \sim N(\underline{0}, V)$$

$$U = (1-\delta)\sigma^2\Sigma_u \quad , \quad V = \delta\sigma^2\Sigma_v$$

In order to estimate this model, the user needs to specify  $\Sigma_u$  and  $\Sigma_v$  up to a scalar factor. Cooley and Prescott also note that, "The process generating the parameters is non-stationary and it is impossible to specify the likelihood function."

Finally, to estimate the model, one must consider a specific realization of the parameter process and condition on some point in time, typically  $T+1$  to forecast  $y_{T+1}$ .

### o Harvey-Phillips model (1982)

(Return to normality model)

$$y_t = \underline{x}_t' \underline{\beta}_t, \quad t = 1, N$$

$$\underline{\beta}_t - \underline{\mu} = \Phi(\underline{\beta}_{t-1} - \underline{\mu}) + \underline{e}_t$$

$$\underline{e}_t \sim N(\underline{0}, \sigma^2 Q) \quad , \quad E(\underline{e}_t \underline{e}_s') = (0) \text{ for } t \neq s$$

$\Phi$  must have eigenvalues in unit circle for stationarity.

$\Phi = (0) \Rightarrow$  Hildreth-Houck model.

Writing  $\underline{\beta}_t = \underline{\mu} + (\underline{\beta}_t - \underline{\mu})$

$$y_t = \underline{x}_t' \underline{\mu} + v_t \quad , \quad v_t = \underline{x}_t' (\underline{\beta}_t - \underline{\mu})$$

As with the other models, this one can also be expressed as a fixed-coefficient model whose errors,  $v_t$ , are heteroskedastic and serially correlated.

This model can be rewritten in state space form and the Kalman filter used to estimate  $\underline{\mu}$ .

A very general stochastic coefficient model was developed by Swamy and Tinsley in 1980.

o Swamy-Tinsley model (1980)

$$y_t = \underline{x}_t' \underline{\beta}_t$$

$$\underline{\beta}_t = \Pi \underline{z}_t + \underline{\epsilon}_t$$

$$\underline{\epsilon}_t = \Phi \underline{\epsilon}_{t-1} + \underline{a}_t \quad \underline{a}_t \sim (0, \sigma^2 \Delta)$$

The most general formulation allows for  $\underline{\epsilon}_t$  to follow a vector ARMA(p,q) process.

Writing,

$$\begin{aligned} y_t &= \underline{x}_t' \Pi \underline{z}_t + \underline{x}_t' \underline{\epsilon}_t = \underline{x}_t' \Pi \underline{z}_t + u_t \\ &= (\underline{z}_t' \otimes \underline{x}_t') \text{vec}(\Pi) + u_t \end{aligned}$$

and defining,

$$\Gamma = E(\underline{\epsilon}_t \underline{\epsilon}_t')$$

one can show,

$$E(u_t u_{t-s}) = \underline{x}_t' \Phi^s \Gamma \underline{x}_s$$

As before, the result is a fixed-coefficient model with heteroskedastic and serially correlated errors.

The estimation algorithm ensures that  $\hat{\Phi}$  has eigenvalues in the unit circle and  $\hat{\Delta}$  is positive semidefinite.

Forecasts are generated from:

$$\hat{y}_{T+s} = \underline{x}_{T+s}' \hat{\Pi} \underline{z}_{T+s} + \underline{x}_{T+s}' \hat{\Phi}^s \hat{\epsilon}_T$$

By placing restrictions on  $\Phi$  and  $\Delta$ , one can obtain many familiar models as special cases.

A good reference for this topic is "The Stochastic Coefficients Approach to Econometric Modeling" Parts I, II and III, Journal of Agricultural Economics Research, 1988-1989, Swamy, Conway, and LeBlanc.

## The FAA Forecasting Methodology

Gene S. Mercer<sup>1</sup>

**Abstract.** *The Federal Aviation Administration (FAA) forecasting process is an interactive system that combines econometric and time series model results with aviation industry forecasts, expert opinions, and anticipated policy impacts to derive a set of FAA aviation forecasts used in decisionmaking. The first step in developing the forecasts is to enter the economic and demographic variables into a set of econometric models or equations that represent a simplified version of the real world. The initial model results are reviewed, revised, and adjusted to reflect the analyst's best judgment of the effects of the events which are occurring or are expected to occur during the forecast period.*

The Federal Aviation Administration (FAA) forecasting process is an interactive system that combines econometric and time series model results with aviation industry forecasts, expert opinions, and anticipated policy impacts to derive a set of FAA aviation forecasts that are used in the decisionmaking process. Figure 1 shows a generalized version of the FAA aviation forecasting process.

Forecasting aviation activity is an essential component of the FAA's planning process. The forecasts are used to determine staffing levels and capital expenditures that will be needed to accommodate growth of activity in a safe and efficient environment. The forecasts are also used for short-term budget preparation, cost-benefit analyses, and safety analyses. The relative importance of the forecasting function in the planning process can be gauged by examining the major changes being made to the National Airspace System during the next 10 years. These changes are being made, in large part, to accommodate the projected growth in air traffic.

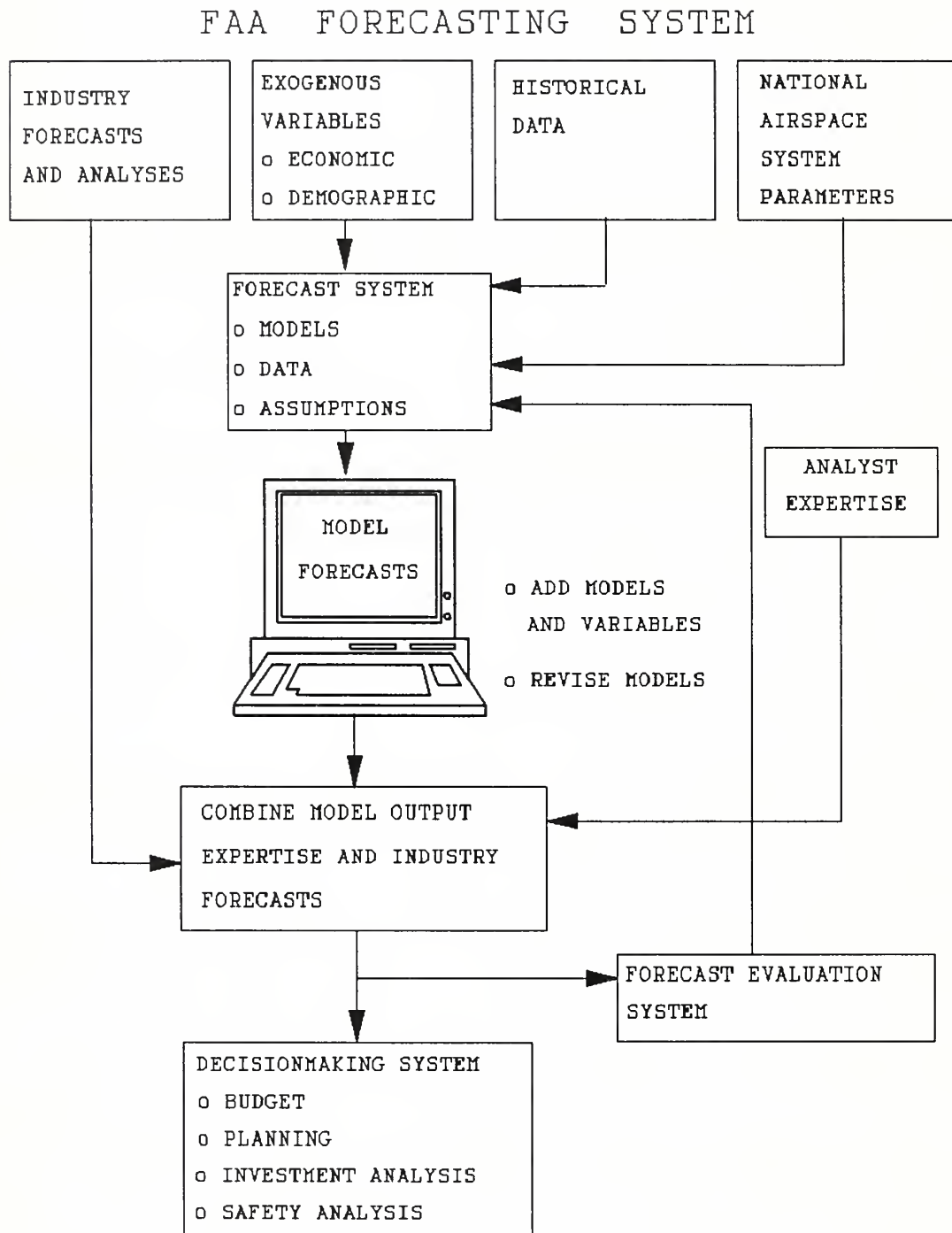
In rebuilding the air traffic control and air navigation systems, the FAA is installing new aircraft landing systems, developing new radar and communication systems, and upgrading weather services to aircraft operators. Because of the sizeable investments being made in the National Airspace System, it is essential that the FAA develop and utilize the most accurate and reliable forecasts possible. Consistently large forecast errors will lead to inefficient allocation of scarce resources. Thus, review and evaluation of the FAA forecasting procedures, models, forecast assumptions, and forecast results constitute an essential part of the process.

The first step in developing the forecasts is to enter the economic and demographic variables into a set of econometric models or equations that represents a simplified version of the real world. The economic and demographic variables (the truly independent and exogenous variables) are developed outside the

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<sup>1</sup>Federal Aviation Administration, U.S. Department of Transportation.

Figure 1



FAA and, therefore, are not within the analysts' control. It is evident that the degree of accuracy of the forecasts of aviation activities depends on both the accuracy of the forecasts of the independent variables and the ability of the models to portray activities in the real world. Unfortunately, a number of external events have occurred that have significantly altered the basic structure of the aviation industry, which casts further doubts on the reliability and validity of our econometric models.

The mechanical execution of forecast models is only the first step in producing a set of forecasts. In general, these models and equations are simple portrayals of a complex system. They cannot account for a number of political, social, psychological, and economic variables and all the interrelated actions and reactions that eventually lead to a particular set of results. Consequently, the initial model results are reviewed, revised, and adjusted to reflect the analysts' best judgment of the impacts of the events which are occurring or are expected to occur during the forecast period.

To help the analysts make correct decisions and informed judgments when developing the forecast assumptions, FAA holds a series of meetings with industry representatives to discuss industry trends, recent developments, and possible future courses of events. Every 2 years, for example, FAA, in cooperation with the National Academy of Sciences, Transportation Research Board (TRB), sponsors a forecast assumptions workshop. This workshop is attended by 70 to 80 industry planners and forecasters representing the airlines, aircraft manufacturers, engine manufacturers, and other industry groups.

The participants in various subgroups identify specific assumptions about the short-term and long-term future trends of the economic and aviation variables that are important to their segments of the industry, indicate why these are considered important, and show why specific trends are anticipated. After discussing the assumptions, the entire group attempts to reach a consensus about the key variables affecting the industry and the most likely future courses of these variables. Finally, the TRB prepares and publishes a workshop report. The participants benefit from the discussions, and the analysts have the TRB workshop report as a benchmark for preparing forecasts or for evaluating forecasts prepared by other organizations. FAA uses this forum and the workshop report in preparing and in evaluating its aviation forecasts.

Formal and informal meetings with individuals and representatives of specific industry groups represent other avenues used by the FAA to promote dialogue and discussion with the aviation community and to solicit input and comments. Separate meetings are regularly held with the aircraft manufacturers, as a group, with members of the Air Transport Association, and with members of the General Aviation Manufacturers Association. In addition, FAA analysts maintain one-on-one contact with industry representatives.

Another step in the FAA aviation forecast process is the public dissemination of the forecast results, solicitation of industry comments, and critique of the forecasts. The main avenue used for this purpose is the FAA Aviation Forecast Conference held annually in February or March. The 500 to 600 participants at the conference generally include airline executives, aircraft and engine manufacturers, consumer groups, and other industry representatives, and the news media. To the maximum extent possible, FAA responds to questions raised about the forecasts both during and after the conference.

An important part of the conference is the opportunity for various segments of the aviation community to make technical presentations on a variety of topics of interest to the aviation community. The FAA aviation forecast conference establishes avenues of communication through which FAA releases its forecast to the aviation community and the public and receives comments, criticisms, and feedback about the forecasts. The FAA also receives valuable information and insights through the papers presented at the forecast conferences.

FAA also seeks to improve the forecast accuracy and credibility by inviting FAA regional and State participation in the forecast process. For example, facility level terminal area (airports) forecasts and flight service station forecasts are circulated to FAA regions for review and comments. The comments and suggested changes are reviewed and, when possible, incorporated in the final facility level reports. In the case of the terminal area forecasts, the FAA regions have the capability to make changes by computer. The final facility level forecasts derived by this procedure must be consistent with the national forecast. The FAA has now developed and distributed to State aviation planning authorities a personal computer version of the terminal area forecasts. This provides them with 15 years of historical and 15 years of forecast data for every public-use airport in their State. They have the ability to revise the data, create reports, and evaluate an airport's future eligibility for Federal facilities such as instrument landing systems. In turn, the States provide the FAA with valuable input as to the current and future status of the airports that they are most familiar with.

In April 1989, the FAA cosponsored with the TRB a special workshop on aviation forecasting methodology. The purpose of the workshop was to examine techniques and practices currently used by the FAA and other aviation forecasters and to explore other methodological approaches. The workshop focused on the forecasting process and ways to improve the reliability and utility of forecasting results. A followup workshop is now scheduled for mid-September to review some of the accomplishments of the workshop recommendations. The general conclusions were:

- (1) The present FAA forecast procedure appears to produce results that are satisfactory for the purposes intended--anticipation of workload and facility requirements 10 years ahead.

- (2) While past FAA forecasts, particularly in the years since airline deregulation, have underestimated traffic growth, inaccurate forecasting is not a primary cause of the present shortage of capacity in the air transport system. The chief reasons are lack of funding and inability to achieve consensus on the need and timing for airport and air traffic control system expansion.
- (3) The FAA forecasting process can be used for a wider range of purposes, than it is now--for example, exploring contingencies, alternative scenarios, and prospective policies and programs.
- (4) For longer term forecasts, FAA may wish to consider: (a) expanded use of demographic and employment data, (b) use of megatrends to assess the role of aviation in a more comprehensive view of society, and (c) predictions of fossil fuel supply and demand.
- (5) For its short-term models, FAA may wish to explore ways to utilize variables such as airline yield, price, unit costs, and market segmentation.
- (6) There is a need for broader and better data on market developments and travel behavior.
- (7) In developing its forecasts, FAA may wish to expand its program to obtain a broad consensus on critical assumptions from a cross-section of industry representatives (airlines, other airspace users, aircraft manufacturers, and airports).

The evaluation of the forecast process proceeds on several fronts. On a monthly basis, FAA tracks its short-term forecasts of aircraft operations, instrument operations, aircraft handled, and flight services vis-a-vis the actual counts at the facilities. This tracking system alerts FAA management to unexpected deviations from the trends suggested by the forecasts. Inquiries are then initiated to determine the cause(s) of the differences, and revised short-term forecasts may be generated, if necessary.

As you can see, the FAA forecasting process is both continuous and iterative. As such, it is important to evaluate the forecast results and to determine the basis of the deviations of the forecast values from the actual values observed in the real world. The analysis of the errors generally identifies the cause of the deviations and helps in determining the proportion due to improper model specifications, erroneous forecasts of independent variables, erroneous forecast assumptions, or incorrect analysts' judgments and opinions. If warranted, the forecast error analysis may lead to a reformulation of the model and to additions or deletions of independent variables, revisions of forecast assumptions, and/or changes in analysts' opinions and judgments about future events.

# Creating Strategic Visions with the "Cone of Plausibility"

Charles W. Taylor<sup>1</sup>

***Abstract.** Every Federal agency should have a strategic outlook of the future. Most agencies pursue their projections into the future differently and independently from one another, but few share their planning of future views throughout the Federal Government. Federal forecasters have not considered a common approach or model to use for creating strategic visions or scenarios. This presentation discusses the concept of the cone of plausibility and offers it as an acceptable model and process for most forecasters to create strategic visions of the future.*

The process I am going to discuss is a forecasting and planning model that is suitable as a standard for creating strategic visions for government, business, industry, or academia (1).<sup>2</sup> It has three attributes that assure its success. First, the process is highly acceptable to chief executive officers (CEO's) and top managers. Second, the product of the process is plausible, that is, believable; and third, because of the assurances built into the process, the model and the final product are marketable.

## **Acceptability**

The process achieves acceptability because of the logical ways it brings a variety of players together to create visions of the future. These players are futurists, scenario writers, experts, and planners.

Futurists and scenario writers work together. They meet and discuss past, present, and future problem subject areas with the other players in the process. Futurists, external to the organization, provide broad and relevant environmental strategic forecasts. These are scenarios for planning. Scenario writers, also external to the organization, provide consistency within each scenario and a harmony between alternative scenarios.

Experts, internal to the organization, assure data and contextual accuracy, as well as plausibility, during the process. Planners, also internal to the organization, provide relevant trends and milestones for scenario development. Additionally, the planner reveals the real problem areas associated with the projection of trends into the future. What builds the acceptability into the process is that CEO's and top managers can be brought into the process at any step to observe its logic, ask pertinent questions, offer suggestions, and, in general, develop a

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<sup>1</sup>U.S. Army War College, U.S. Department of Defense. The views expressed in this presentation are those of the author and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

<sup>2</sup>Underscored numbers in parentheses refer to sources listed in References.

belongingness as well as an ownership of the forecasts and scenarios.

Under the leadership and direction of a futurist, this diverse group brings the power of visioning and creativity together to construct strategic visions, step by step, through the process into the future.

### **Plausibility**

The process and the strategic scenarios produced by it assume plausibility through the use of a theoretical cone, called the "cone of plausibility." The object of the cone in the process is to serve as an enclosure that circumscribes the thought processes of the players. Scenarios projected within the cone are considered plausible if they adhere to a logical progression of trends, events, and consequences from today to a predetermined time in the future.

Within the cone, the experts, planners, and futurists track pertinent trends from the past to the present and into the future in a systematic and logical progression. This maintains plausibility and further increases the acceptance of the scenarios. The players can produce one planning scenario or, preferably, alternative scenarios within the cone simultaneously and incrementally.

The evolving scenarios become increasingly believable or plausible to CEO's and top managers who are invited, periodically, to observe the process of the cone in operation. Their participation in this manner keeps them in touch with future realities. Since the players can display a snapshot of their point of progress in the future, called a planning or forecast focus plane, the finished scenarios bring no surprises, or future shock, to the CEO's or managers.

### **Marketability**

The cone of plausibility provides end products, or scenarios, that are marketable because they have been generated through the systematic and logical processes of the cone. As a process in itself, the cone is highly marketable to CEO's because of the enthusiasm it creates in their players, the experts, and the planners.

The cone and its processes offer a means to standardize the methodologies of visioning the future. There is also the possibility that because of the rigors of the processes within the cone, even if not as exacting as those of mathematics, operations research, or systems analysis, the cone brings long-range forecasting and planning closer to a scientific approach.

The cone also tends to stimulate goal setting, solution finding, and creativity in the players, as well as to create new challenges. Of equal importance, it creates a two-way communication between the players and management. These

attributes increase the confidence CEO's and managers have in the cone, the process, the players, and the end-product scenarios.

### **Creating the Strategic Visions**

The players must take several decision steps as they begin to create their strategic visions. For the purposes of this presentation, strategic visions are intuitive, holistic views of plausible realities, and futures used for planning.

First, the players must decide how many scenarios they are going to create. There are galaxies of scenarios that can be created for almost any subject matter. The human brain, however, cannot analyze or process the vast amount of data generated by large numbers of scenarios. Computers and the appropriate software are the tools for handling these situations, provided all data can be expressed quantitatively and software programs are available. Much of the data in the social sciences, however, cannot be converted readily to mathematical form, thus the number of scenarios must be only a few, that is, what the brain can handle.

Experience in generating scenarios has convinced the author of the following: One scenario is predictive. No one can predict the future accurately except by chance. Two scenarios, usually, are best-case and worst-case futures. Three scenarios almost always provide a middle-of-the-road scenario between the best and the worst. Five scenarios or more tend to become increasingly overwhelming in data and cumbersome to manage. Moreover, their number encourages ranking, for example, preferred, least likely, or most probable. Any such ranking tends to be predictive of the future. Four scenarios, however, are manageable and allow considerable flexibility in the number of relevant variables. The use of multiple or alternative scenarios tends to improve forecasting accuracy. Four scenarios are the choice number of scenarios to process through the cone of plausibility.

The second and third decision steps for the players are to determine, by consensus, the 10 most important elements that influence their forecast or planning subject matter, then determine their rank order of importance to the subject matter. These decisions are used by the futurists to create microscenarios.

Microscenarios are made up of the first four ranked elements determined in the steps above plus another four. One set of four short statements reflects positive trend attitudes of the leading influencing elements and the other set of four reflects opposing trend attitudes. After a permutation and sorting of the eight statements, the order of the four final statements in each microscenario set is established at random. The first trend statement of each set becomes the driver trend and the dominant theme for that scenario. The futurists now have prepared four alternative sets of scenarios, each with four trend statements and a dominant theme. These strategic visions can now be processed through the cone of plausibility.

The fourth decision step the players make involves the workshop agenda they will follow as they project the subject matter elements and identify related-element problems in the future. Workshops are about 3 days in length and 5 weeks apart. The participants include largely subject matter experts in four groups, each with planners as facilitators and futurists as motivators.

Based on the microscenarios, the experts create visions of the future for each of the scenarios. The planners lead each group of experts, maintain the peace, and record the group's progress. After each workshop, the planners, in session, create responses to the experts' visions. The planners then set new or modified goals to the experts' scenario projections. The futurists constantly urge the experts and planners to project their thoughts into the future.

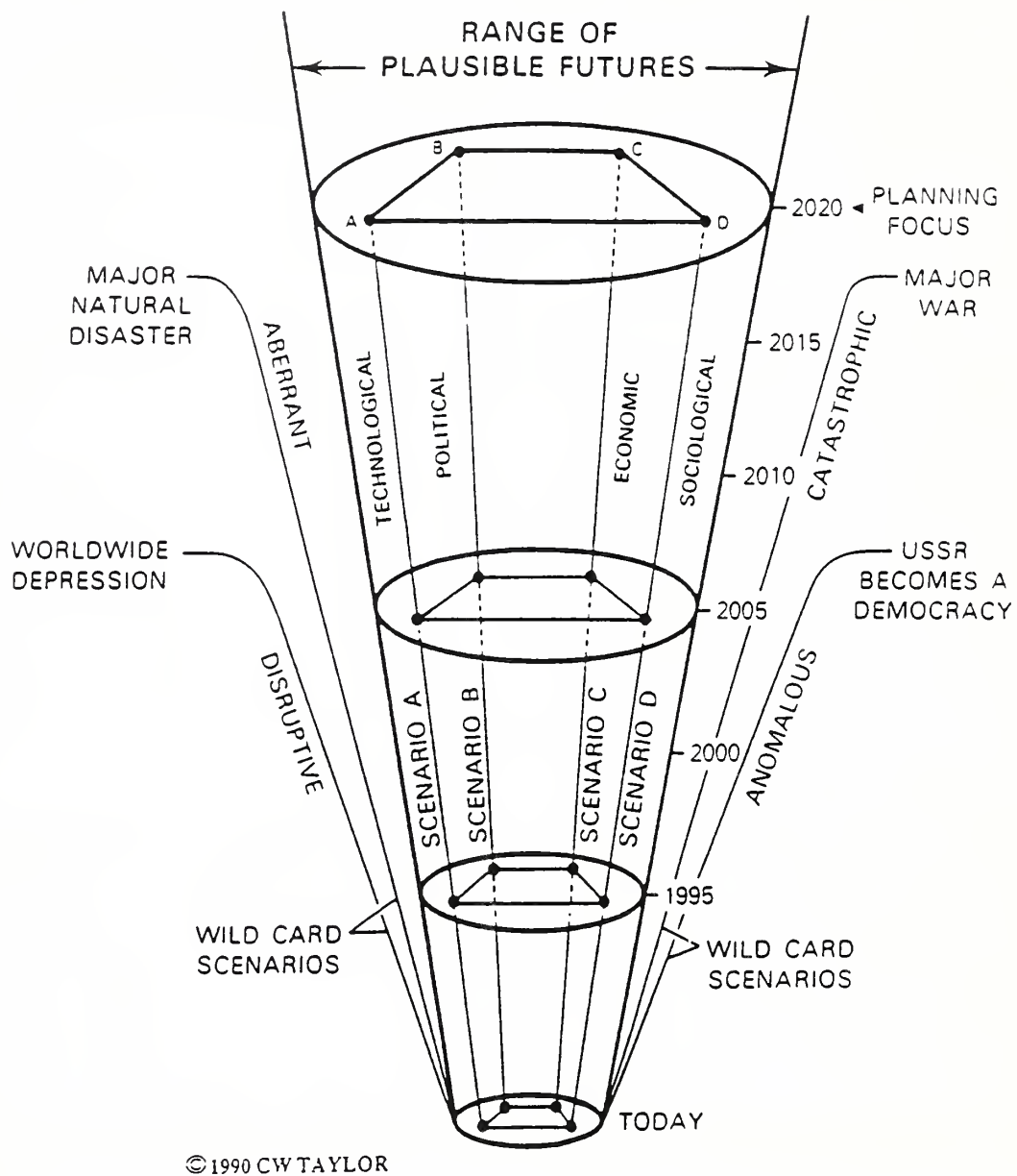
After each expert workshop and planners' response session, the futurists analyze the projections and responses and compare all relevant data with their notions of the future and those found in futurist literature. Along with the scenario writers, the futurists expand each microscenario into a miniscenario of about 500 words in length. The expanded scenarios provide the basis for the next workshops. The author's experience has shown that often scenarios based on the future expectations of experts contain surprises the experts did not anticipate. These surprises may be included in the scenarios by the futurists. This procedure continues for the remainder of the workshops. By the completion of the workshops, each scenario may have expanded to fivefold or more. These scenarios describe the strategic visions of a selected group of experts, planners, and futurists.

### **The Anatomy of the Cone**

The cone of plausibility is a theoretical process that can be used by one person or a group of people to project trends and events and their consequences holistically into the future. It is especially suitable for generating alternative scenarios at predetermined points in time. The generic cone is representative of the thought processes used to create strategic visions of the future and is depicted in figure 1.

The generic cone of plausibility encompasses theoretical projections of four strategic visions or planning scenarios. They are scenarios A, B, C, and D. Each example scenario has a dominant or driver identifier; they are technological, political, economic, and sociological. These identifiers also represent the dominant theme that characterizes each scenario. Each of these themes will command a different vision or scenario of the future. The trends within each theme are not straight-line projections. There are interactions among trends where dominant trends alter the attitude of less dominant trends or result in discontinuities of others. The probability of the strength of a trend or its continuing influence in its scenario can be determined, as can similar trends in the other scenarios.

Figure 1--The Generic Cone of Plausibility



Outside of the cone are wild card scenarios, which, if they occur, overwhelm most other visions or scenarios. These disruptive, aberrant, anomalous, or catastrophic scenarios can dominate almost all other trends and events for a period of time; a time long enough to redirect or destroy any interaction or mutual support existing within and among the planning scenarios. The examples shown with the generic cone, a worldwide depression, a major natural disaster, a major war, and a democracy in the USSR, are representative of wild card events. The influence such events can exert can be observed by studying the past.

As mentioned earlier, experts, planners, and futurists can track trends from the past to the present and into the future in a systematic and logical way through the use of the cone of plausibility. The influence trends have in the environment or society in which they exist can be observed along a continuum from their origin, or from some point of time in the past to the present. Theoretically, within the logic of the cone, the responses to and the consequences of trends and events at any selected focus plane, even if in the past, can be reconstructed to create plausible scenarios or visions of that environment.

This perspective of creating historic visions is depicted in the drawing of a double cone in figure 2 (2). Use of the cone for historic research and analysis is an additional feature of this visioning tool. This historic linkage, moreover, increases the acceptability, plausibility, and marketability of the cone of plausibility. Continued use of the cone builds the mental discipline and conditioning needed to pursue its logic backward or forward in time.

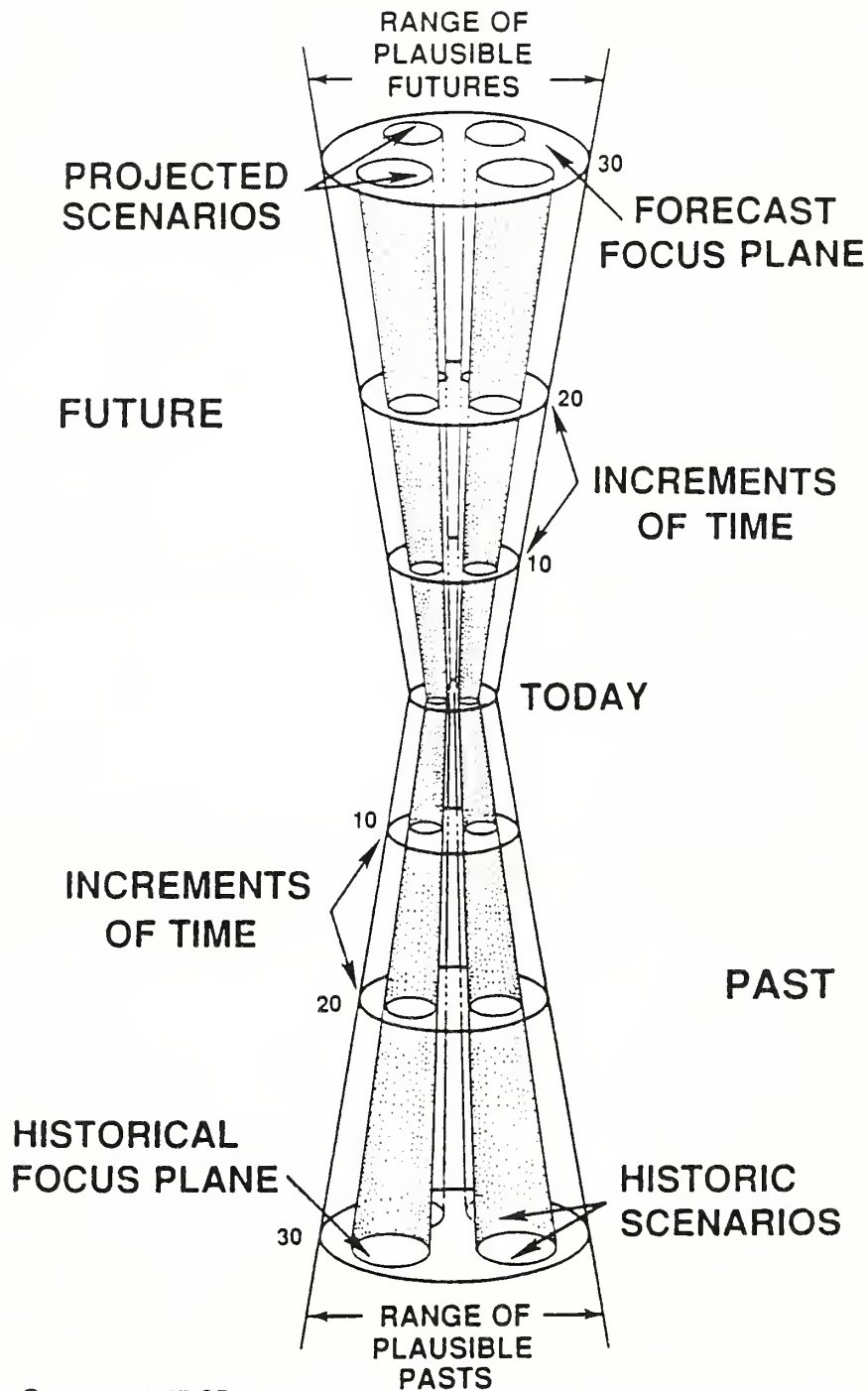
## Conclusions

I have presented the cone of plausibility in this paper along with a new method of creating strategic visions or scenarios. The cone is a new technique that can be used by long-range planners and futurists to achieve a uniformity of process and interrelated forecasting. Standardizing the process of planning and forecasting would be the first step toward developing a standard set of long-range alternative strategic scenarios or visions for government planning. The creation and the use of a standardized set of alternative scenarios would improve the accuracy of government foresight in the long term.

## References

1. Taylor, Charles W. Alternative World Scenarios for Strategic Planning, Rev. ed. Carlisle Barracks, PA: U.S. Army War College, Strategic Studies Institute, 1990, pp. 1-14.
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Figure 2--The Cone of Plausibility: Past and Future



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**Session D: Recent Developments in Forecasting for the Dental,  
Allied, and Associated Health Professions**

Chair: Stuart Bernstein<sup>1</sup>

**Econometric Model of the Dental Sector (EMODS):  
Epidemiological, Economic, and Computer Factors Involved  
in Revising and Updating a Forecasting Model**

Gloria Bronstein, Norman Clark, and Herbert Traxler<sup>2</sup>

***Abstract.** The econometric model of the dental sector (EMODS) has been used by the Bureau of Health Professions for workforce requirements planning since the mid-1970's. EMODS, which forecasts national dental expenditures, employment, and utilization and the price of dental services, has recently undergone major revisions to incorporate clinical and epidemiological developments that affect the interactions of this supply and demand equilibrium model. Economic and demographic variables have also been updated. The model generates alternative economic scenarios based on different assumptions for future gross national product growth.*

The early 1970's saw intense interest on the part of analysts, planners, and policymakers in the development of health sector computer models. Prototypic models were developed within the dental sector at the macro level, using both econometric and systems dynamics methodologies. Microsimulation models were also developed to represent the dental care production process.

The econometric approach was found to perform very well in the dental arena. The dental sector appears to behave according to basic economic principles. Historical data show that individuals seek more dental care as personal income increases. Also, as dental care prices rise relative to other prices, individuals seek less dental care. In economic terminology, the demand for dental care was found to be highly income and price elastic.

In 1974, the then Bureau of Health Manpower let a contract to develop an econometric model of the dental sector. During the contract period, the mathematical structure of the model was specified and the model was computerized.

Approximately 2 years later, the Bureau's Division of Dentistry determined that that model's general structure was satisfactory for incorporating into the Division's dental manpower supply and requirements program. After the model's specifications were

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<sup>1</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

<sup>2</sup>Bureau of Health Professions, U.S. Department of Health and Human Services. The opinions are those of the authors, and no endorsement by Department of Health and Human Services, Public Health Service, or Bureau of Health Professions is intended or should be inferred.

tailored to suit the specific needs of the projection program, it was used to automate the projection program of the Division. This respecified model was called the econometric model of the dental sector (EMODS).

The original EMODS modeled the demand for three types of dental visits according to 24 age/income categories of patients. One of the reasons for this level of detail was the desire to simulate national health insurance programs whose benefits were specific to visit type, age, and income. Its main contribution was seen as the possibility to compare the relative effects of alternate government policies, rather than any specific forecasts.

The original model was eventually replaced by a more streamlined version that eliminated the three visit types and the 24 age/income categories. This simplification came about partly because of a waning interest in national dental health insurance, and partly because available data could not support the development of demand equations and production functions at the original EMODS level of detail. In essence, this move reduced the capability of analyzing national dental health insurance but provided more reliable and easily interpreted simulations in the absence of national health insurance.

During subsequent years, the EMODS has been updated three times. These updates consisted primarily of revisions to parameter estimates but also included some increased capabilities in support of plot generation. It has been more than 10 years since the model has undergone any major revisions and 5 years since model parameters have been updated. As the EMODS continues to be the only econometric model available for dental manpower projections within the Bureau, a contract was let in early 1989 to restructure and update the model in order to improve the dental requirements forecasts. Such forecasts are used for mandated congressional reports and other Bureau activities. This contract is now completed. The new version of the model places it and its data files into a personal computer (PC) environment. The input data files have been reorganized and thoroughly documented for clear understanding. Also, a menu-driven interface to operate the model has been implemented.<sup>3</sup>

### **Oral Health Module**

The restructured EMODS includes a new oral health module. The addition of the new oral health module was necessary to accommodate, among other considerations, the recent changes in clinical and epidemiological disease patterns in the United States. For example, we can generally conclude from recent

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<sup>3</sup>A more detailed history of EMODS and its structure, assumptions, and forecasts, was presented by Herbert Traxler at the 1989 Federal Forecasters Conference: Herbert Traxler, "The Econometric Model of the Dental Sector (EMODS)," outline of presentation at the September 6-7, 1989, Federal Forecasters Conference.

surveys on dental caries prevalence of American children conducted by the National Institute of Dental Research and the 1986 National Survey of Oral Health of U.S. Adults that dental health of most younger Americans is improving, employed adults are retaining their teeth at a significantly higher rate than the elderly, and dental health promotion and disease prevention are benefiting more people than ever before. It is also clear that the difference in oral health status between generations and changing demographics of the population will require the dental profession to provide a different mix of dental services in the future. Dental services will be shifting from children to the elderly, who generally require more complex dental procedures. How the general improvement in oral health will affect demand for dental services remains uncertain, but the restructured model will improve the confidence levels of future forecasts.

### **EMODS Structure and Assumptions**

Some general statements about EMODS development and structure were made earlier in this presentation. EMODS is an economic equilibrium model, whose major components are the supply of and the demand for dental services. Interactions between supply and demand cause the price of dental services to move to a level where the quantity of dental services supplied equals the quantity demanded, in the true fashion of classic economic theory. Specific assumptions of future underlying conditions (inflation, incomes, gross national product, and supply of dentists) and governmental policies affecting these conditions are external to the model. The interactive mathematical equations of the EMODS framework result in calculated future values for expenditures for dental services, the price and number of dental services, number of dentists, dental utilization, dental income, prices of equipment and supplies, and number of dental auxiliaries.

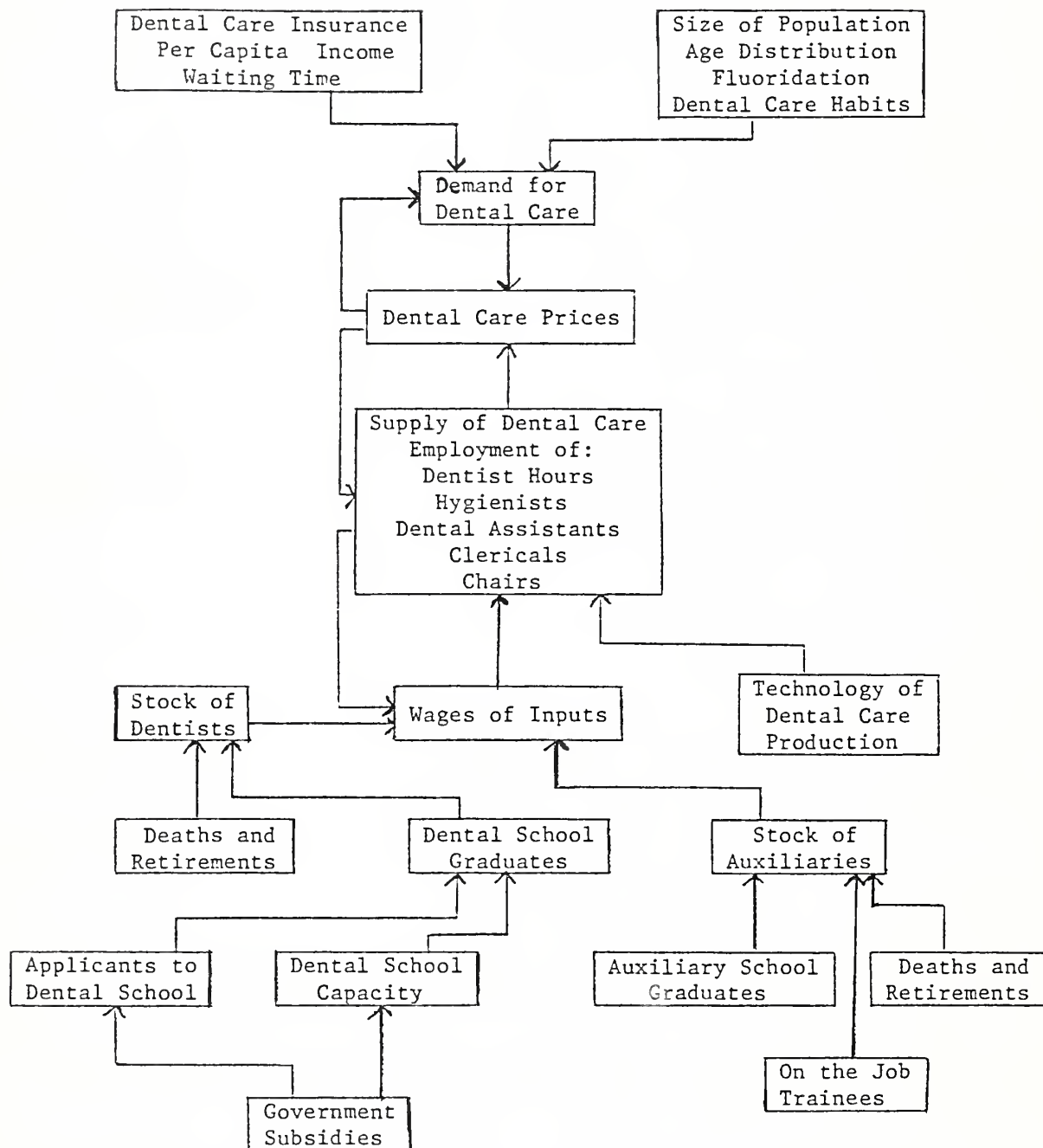
In short, EMODS models the dental sector as an economic system in which the demand for care depends upon the size of the population, average per capita income, and the price of care. The price of dental care moves to that level where the amount of care that dentists are willing to supply is just equal to the amount that the population demands. The revised EMODS model will take into account special economic conditions which have been changing and will affect the future demand for dental services--such as the rise in dental insurance and changes in practice characteristics and environment.

Figure 1 depicts the model's basic interrelationships.<sup>4</sup> (This diagram is from a 1980 publication on EMODS, and therefore does not include the recently added oral-health module.)

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<sup>4</sup>U.S. Department of Health, Education, and Welfare. The Econometric Model of the Dental Sector: Purpose, Scope, and Uses. DMA Report No. 80-44, March 1980.

Figure 1



## Computer and Programming Considerations

In past years, the EMODS model was run on an IBM mainframe. The contract just completed, primarily to add factors reflecting clinical and epidemiological changes and to update the data, of necessity involved rewriting the computer program. This presented an opportunity to consider converting implementation from mainframe to a PC. The language used in prior versions of EMODS had always been FORTRAN. Although major modifications of the program were always done by the contractor, minor programming changes or those of intermediate complexity were done in-house by a user experienced in the FORTRAN language. The difficulty of an in-house programming task was not the language but the complex interactions of the mathematical equations. In addition, there was always the danger of accidentally tampering with the "black box" and causing the model to go haywire.

The contractor proposed using the C programming language for the new user-friendly PC version. Objections from several of the office staff included not only those directly involved in modifying parameters and data and running the model under different economic scenarios, but also those who might inherit the computer tasks at a future date. The objections related to not having anyone in-house familiar enough with the C language to be able to make programming modifications. Expertise in C requires not only adequate training but continued opportunity to work with applications in C. (Most of our applications currently involve SAS, both on mainframe and PC, PL/1, and several software packages for graphing and mapping.) However, since C appeared to be the language of choice because of its particular suitability for designing and executing the interactive modules needed, and the contractor's staff was experienced with using C for such applications, it was decided to go with C.

Early test versions for the PC in April and May proved indeed to be very user friendly and flexible for data and parameter modifications. These versions, however, were to test the interactive features implemented by C and used the old model--that is, they did not yet include data updates or revision of the econometric model itself. The final PC package, with revisions and updates, was received in mid-August. One of our requested additions, which we are pleased to have implemented, was a modifiable heading that describes the run. This may seem quite trivial, but as users you will no doubt appreciate having output labeled with more than just a date; we are now able to append to the date line a heading indicating "High Growth" or "Low Growth," "Scenario 1" or "Scenario 2," and/or "GNP=3.1" or "GNP=4.5"--simple, but practical and needed.

All modifiable variables and parameters are now separate from the program; they reside outside the black box. The prior versions had imbedded some of the modifiable data in the program itself. Disappointingly, interactive parameter and data modifications are only temporary; one has to go to an external editor to make permanent data changes.

Looking at the PC screen, the user progresses through the menu selections, modifying some (or none) of the parameter variables (for 1 or more years), selecting table outputs (for 1, or more, or all years through 2020), and executing the model. During execution, the user sees the model cycling through the projection years in the screen window.

### **Use of Forecasts**

Some of the economic variables involved in this dental requirements model are shown in the dentistry chapter of our (biennial) Seventh Report to the President and Congress on the Status of Health Personnel in the United States.<sup>5</sup> Appended table 1 from that report to Congress displays the forecast of the economic activity in the dental sector, using two scenarios: higher economic growth and lower economic growth. Footnotes 2 and 3 of that table describe in detail the two gross national product projection series used. The indexes shown were calculated from outputs of the model.

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<sup>5</sup>U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions. Seventh Report to the President and Congress on the Status of Health Personnel in the United States. Publication No. HRS-P-OD-90-1, March 1990.

Table 1--Forecast of economic activity in the dental sector,  
based on Department of Commerce data, 1988-2000 1/

Year	Scenario number one: Higher economic growth <u>2/</u>				Scenario number two: Lower economic growth <u>3/</u>			
	Annual growth rate of GNP	Real price	Real exp.	Exp./ dentist	Annual growth rate of GNP	Real price	Real exp.	Exp./ dentist
	Percent	Index			Percent	Index		
1988	4.4	100	100	100	4.4	100	100	100
1989	2.9	101	104	103	2.9	101	104	103
1990	2.3	102	107	105	2.3	102	107	105
1991	2.2	102	110	106	2.2	102	110	106
1992	2.2	103	113	108	2.2	103	113	108
1993	2.3	103	116	110	2.3	103	116	110
1994	2.3	104	120	113	2.3	104	120	113
1995	2.3	105	124	116	2.1	105	123	116
1996	2.3	106	127	119	1.9	106	126	118
1997	2.3	107	131	123	1.9	106	129	121
1998	2.3	108	136	127	1.8	107	133	124
1999	2.3	109	140	131	1.7	108	136	126
2000	2.3	110	144	135	1.6	108	138	129

1/ Real price, real expenditures, and real expenditures/dentist are presented as indexes with the base year 1988 (that is, 1988 = 100). Real denotes that the figures have been adjusted for inflation by dividing by the overall consumer price index. Dental expenditures in 1988 were \$27.111 billion (current dollars). Real price is defined as the ratio of the dental component of the consumer price index to the overall level of the consumer price index. For the purpose of this report, the real price was standardized at 100 in 1988. Forecast prices were generated by the Bureau's EMODS model, using the Congressional Budget Office's (CBO) and the Old-Age, Survivor's Disability Insurance (OASDI) Program's forecasts of inflation as noted in 2/ and 3/ below.

Actual expenditure data through 1988 are from the National Income and Product Accounts, Department of Commerce. Forecasts of expenditures were generated by the Bureau's EMODS model.

2/ For scenario one, gross national product (GNP) rates are from the CBO's 1989-1990 short-term economic forecast and 1991-1994 medium-term projections. CBO's 1994 projection of 2.3 percent has been extended and kept constant through 2000.

3/ For scenario two, GNP figures for 1989-1994 are from the CBO, as noted for scenario one above. OASDI's "pessimistic" projections, based on their Alternative III assumptions, have been used for 1995-2000.

# Recent Developments in Developing and Documenting a Supply Model for the Nation's Pharmacists<sup>1</sup>

Fred G. Paavola<sup>2</sup>

**Abstract.** In 1972, the Bureau of Health Professions developed a supply projection model to predict the current and future supply of pharmacists in this country. This model used a base number of pharmacists from a census conducted in the 1970's, added graduates and subtracted pharmacists for workforce separation. The Bureau is developing a new model for microcomputer use which will include other variables that affect the total workforce. These factors include outmobility of pharmacy graduates before entering the workforce, foreign pharmacy graduates, occupational outmobility, and the extent of participation in the workforce. The amended model may be adapted to predict supply in other health professions.

An integral component of the Bureau of Health Professions (BHP) mandate from Congress to establish a program to collect, compile, and analyze data on health professions personnel in the United States is the ability to make estimates and projections of those health professions. The model that has been used to estimate and project the number of pharmacists in the United States was developed in 1972, as part of the supply, output, and requirements model (SOAR). The model was developed utilizing PL-1 program language on a mainframe computer. The number of pharmacists that serves as a base for this model is from the 1978-80 inventory of pharmacists (84-percent response rate) conducted by the American Associations of Colleges of Pharmacy and the National Center for Health Statistics through its Cooperative Health Statistics System. This model is represented by the following mathematical equation:

$$T_y = \sum_{a=0}^{75} T_a + G_y$$

$a \leq 24$

$T_y$  = total active pharmacists in year  $y$ ,

$T_a$  = total active pharmacists of age  $a$  in year  $y$ ,

$G_y$  = pharmacy graduates in year  $y$

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<sup>1</sup>K. Knapp, F. Paavola, and H. Manasse. "Models for the Supply of Pharmacists," Evaluation & The Health Professions. Vol. 13, No. 3, September 1990, pp. 343-363.

<sup>2</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

where

$$T_a = {}_wT_a (1 - {}_wr_a) + {}_mT_a (1 - {}_mr_a)$$

${}_wT_a$  = total active female pharmacist of age a,

${}_wr_a$  = separation rate for female pharmacists of age a,

${}_mT_a$  = total active male pharmacist of age a,

${}_mr_a$  = separation rate for male pharmacists of age a.

The gender- and age-specific variables for separation from the workforce  ${}_wr_a$  and  ${}_mr_a$  were derived from two sources. For males, the rates were from a 1968 study by the Bureau of Labor Statistics. For females, the rates were from a 1973 study by the Bureau of Labor Statistics.  $G_y$  is the number of actual graduates as reported by the American Association of Colleges of Pharmacy for year y, and third-to-last year enrollment numbers (less gender-specific attrition rates) are also used which permit the model to predict graduates for the next 3 years.

Estimates and projections of the number of pharmacists in the United States have been made utilizing this equation for all seven Reports to the President and Congress on the Status of Health Personnel in the United States. The fifth and sixth reports have received considerable scrutiny from the profession when the public perception of a shortage of pharmacists disagreed with conclusions of the reports that supply and requirements were in balance. This criticism led us to examine the supply model.

Consideration was given to the variables and the data in a supply model equation that would produce valid projections. These variables were compiled from several sources of published health workforce studies. Variables and data that were considered included number of pharmacists, separation rates, demographic data, density and distribution, educational preparation, foreign pharmacy graduates, percent participation in the workforce, pharmacy school enrollment and trends, postgraduate education, and population trends.

Each variable was considered for its individual impact on the pharmacy workforce. The following equation represents the new supply model which incorporates all the supply-related variables:

$$T_y = \sum_{a \leq 24}^{75} T_a + G_y$$

$$T_a = ({}_wT_a \times {}_wF_a(1 - {}_wr_a - d_a)) + ({}_mT_a \times {}_mF_a(1 - {}_mr_a - d_a))$$

where

- ${}_wT_a$  = total active female pharmacists of age a,
- ${}_wF_a$  = percent full-time equivalent of female pharmacists of age a,
- ${}_wr_a$  = separation rate for female pharmacists of age a,
- ${}_mT_a$  = total active male pharmacists of age a,
- ${}_mF_a$  = percent full-time equivalent of male pharmacists of age a,
- ${}_mr_a$  = separation rate for male pharmacists of age a,
- $d_a$  = separation rate due to occupational outmobility at age a,

and

$$G_y = {}_tG_y (1 - d_{25}) + {}_fG_y$$

where

- ${}_tG_y$  = total pharmacy graduates,
- $d_{25}$  = occupational outmobility rate at age 25 or less,
- ${}_fG_y$  = foreign pharmacy graduates admitted to practice in year y.

This improved supply model accounts for new graduates from schools and colleges of pharmacy that after graduation immediately pursue another occupation or activity. The model also adds foreign pharmacy graduates who successfully pass a licensure examination in one of the States. Other variables added to the new equation are for occupational outmobility, where a pharmacist makes a career change and the percent of full-time equivalent participation in the workforce.

Currently a contractor is developing a computer model utilizing the variables presented above. The new model is being developed utilizing Quattro Pro for use on microcomputers. Although the supply model is comprehensive, research is now required to address those variables that do not have values. Some of the data needed will be provided by the forthcoming pharmacist census as well as updating the supply base used in the model.

Concepts developed in the pharmacy supply model are being adapted for other health professions in the Bureau. It is planned to share the model with the profession and others interested in supply projections and research.

## The Development of a Microcomputer Version of a Large Mainframe Supply Model: Updating SOAR (Supply, Output, and Requirements)

Stuart Bernstein<sup>1</sup>

**Abstract.** *The Bureau of Health Professions' Division of Associated and Dental Health Professions has for years used the National Institutes of Health mainframe computer to forecast the supply of optometrists, dentists, pharmacists, veterinarians, and other health care professionals. To make this model accessible to associations and educators, we used Lotus 1-2-3 spreadsheets for replicating the model. Recently, however, we began developing a more rigorous version of the model using Quattro Pro. This model permits modification of first-year enrollments, graduates, separation rates, attrition, and workforce participation for these disciplines. The model also uses the latest available base data.*

The Bureau of Health Professions (BHPr), an agency of the Department of Health and Human Services, has been utilizing for most of the past two decades a model to forecast the supply of a number of health professions. These forecasts are required for inclusion in the legislatively mandated Report to the President and Congress on the Status of Health Professions Personnel, submitted on a biennial basis. The model was programmed utilizing PL-1 and was installed on the National Institutes of Health mainframe computer system. Because of this fact, the model has been accessible only to registered users of this computer system.

The BHPr supply forecasting model was originally developed to provide forecasts of supply of physicians, optometrists, pharmacists, veterinarians, and podiatrists. The physician modeling effort was spun off by our Division of Medicine into a more complex model which I believe is being described in detail in our Bureau's other session. In addition, in subsequent years, dentists were added to the forecasting model.

I will now describe, in brief, how the model works for each discipline. The variables input into the model are the following: a base year distribution of the profession, which describes the profession by age and by sex, historical first-year enrollments and projected first-year enrollments, historical and projected graduates, an attrition rate which represents the proportion of first-year enrollees who do not graduate or conversely a completion rate, a set of age- and sex-specific separation rates which are in actuality separate rates for retirement from the labor force and mortality. In addition, the model utilizes the proportional distribution of graduates by age and by sex.

In all cases, the model utilizes the most current information for all disciplines. For example, the base year distribution is generally obtained from the most recent survey or inventory data. However, in some cases, this data can be nearly a decade old. The base year age-sex distribution represents the beginning point of

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<sup>1</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

the model. In each year, graduates are added to the base year distribution. These graduates are obtained from either actual data or by application of an attrition rate to actual or projected first-year enrollment. The graduates are fed into the model according to the age-sex distribution of graduates reported from actual data. At the same time, the existing active pool of manpower is separated out by age and by sex, utilizing the age- and sex-specific mortality and retirement rates. After this process takes place, the existing supply is then aged 1 year and the process is repeated.

This model over the years has served us well; but, as I stated, the unfortunate thing was that the results could not be replicated unless one had direct access to the computer system upon which it was run. For this reason, I developed a microcomputer version of the mainframe model, one that utilized Lotus 1-2-3 software. While this model worked reasonably well, it had several important drawbacks. It was rather slow in performing the necessary operations and yielded results that were not as precise as we would have liked in replicating the results of the mainframe model.

Because there has been increasing outside interest in replicating the projections included in our reports to Congress, particularly on the part of health professional associations, we decided to try again to develop another microcomputer version of our mainframe supply model. A purchase order was awarded to the same programmer who programmed our existing supply model as well as complex requirements models. It was his judgment that the process should be accomplished utilizing Quattro Pro software, rather than Lotus 1-2-3.

The work related to the development of the microcomputer version of the mainframe model is now well along. Under the purchase order, our programmer is initially developing the model for the discipline of pharmacy. After completion and approval of this discipline, he will then begin reprogramming efforts for dentists, optometrists, and veterinarians. The input works exactly like the mainframe model. Projections nearly duplicate totals obtained from the mainframe model. I will now describe the output obtained from the new microcomputer model for pharmacy. As with the mainframe model, there are three sets of alternative projections possible, each based upon different assumptions relating to first-year enrollments.

Initially, there is a set of pages showing the enrollment and graduate inputs by sex and by year for each of three assumptions. In addition, the completion rates utilized to produce these graduates are shown. Graduates, as imputed into the model, are shown separately for each year. Projections produced are broken out into active base only and active base and graduates for male and females separately for each year. These runs are also repeated for new graduates from the base year forward. In addition, projected net graduates by single year of age, for each year, after separation rates are applied are shown.

The new microcomputer version of the model will permit extensive cohort analysis of graduates beyond what could be seen from output in the mainframe model. Manpower for each discipline can now be better analyzed for 5-year cohorts of graduates with expected behavior being observed over time.

As stated, this model is now in development in BHPr. I expect it will be available for selected outside users in the next 6 months. If you have any questions on specifics of the model or its potential, you may contact me.

# Methodological Approaches to Manpower Requirements Modeling for the Allied Health Professions

Jessica Tabb<sup>1</sup>

***Abstract.** We are constantly reminded of the shortages that exist among many of the allied health professions. To properly measure these perceived shortages, we need to answer the need for technically sound but simple requirements estimation procedures. What do we need to know to determine national requirements? What are the appropriate measures, and what professional issues are driving the current workforce? This presentation describes the basic model and the assumptions that make it reasonable for national level projections of physical therapists and their assistants.*

It is a pleasure to be with you at this session which calls for updates on initiatives within the Division of Associated and Dental Health Professions, Bureau of Health Professions (BHP), and the manpower requirements study project. As you know, our programs promote health professions' education and training for all health professions, as well as for allied health professions. We do this through various initiatives but mostly through grant funding and research and development projects such as the one I will discuss with you today.

Much of our attention centers around the issues of health care manpower/personnel shortages and the factors that affect the supply of allied health practitioners. Several of the significant factors are:

- o Trends in the labor force,
- o Trends in education, and
- o Education financing and grant programs.

Also, attention is given to the forces that drive demand for health care, such as:

- o Population growth and demographic trends,
- o Disease patterns, such as Acquired Immuno-Deficiency Syndrome and chronic disease,
- o The structure of the health care industry and financial incentives, and
- o Technological advancement and change.

Given present economic conditions, the diminishing size of the college-age population, students choosing careers outside the health care field, the decreasing availability of allied health programs (on the supply side), the aging of the population, changing disease patterns, and technological advances in health care (on the demand side), we know that there is an imbalance between supply and demand for some groups of allied health

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<sup>1</sup>Bureau of Health Professions, U.S. Department of Health and Human Services.

professionals. However, this does not apply equally to all allied health occupations or to all geographic locations.

Supply and demand of practitioners varies from place to place, by category of site and within different disciplines. Thus, it is conceivable that a national shortage would be exhibited only in a particular region of the country or sector of the health care system.

Initiatives within the Bureau regarding these issues have been researched and include data collection activities of estimating supply of allied health professionals, BHP's use of Bureau of Labor Statistics data in estimating supply of allied health professionals, and econometric modeling for dentistry. Our most recent project investigates estimation for requirements for physical therapists and occupational therapists.

### **Project Development**

Health manpower issues and concerns include trying to determine whether there is, or will be, a sufficient number of health practitioners of a certain kind to provide an acceptable level of health care. We often inquire about appropriate standards for health manpower requirements. While a variety of methodologies have been developed in order to estimate health manpower requirements, producing a considerable range of estimates for any given occupation, no single methodology has been found to be universally acceptable or the most adequate for all situations, underlying factors, data, and geographical area. Thus, there is no consensus on what any standard should attempt to measure nor how the measurement should be made.

The primary objective of this study is to develop alternative approaches to estimating national-level requirements for occupational therapists and physical therapists. Available evidence suggests that while the demand for allied health personnel has been increasing steadily, the supply of personnel has not kept pace, resulting in widespread shortages in many allied health occupations. The two fields of concern in this study--occupational therapy and physical therapy--appear to be particularly affected by manpower shortages.

For example, the American Occupational Therapy Association (AOTA) reports numerous vacancies in occupational therapy positions in hospitals and nursing homes. Likewise, physical therapists provide a wide range of services designed to restore function and prevent physical disability resulting from disease and traumatic injury. In addition to working with patients in hospitals, physical therapists and their assistants provide services in health maintenance organizations (HMO's), private practice, rehabilitation centers, nursing homes, home health agencies, and academic institutions.

An understanding of the kinds of tasks that occupational therapists, physical therapists, and their assistants fulfill is essential to the development of this model. Relatively scant

attention has been given to the allied health professions in general and the rehabilitative professions in particular. As proposed, this study focuses on determining the kinds of conditions these personnel treat and the numbers of such personnel that are required to provide care.

### **Approaches to Manpower Modeling**

The methodological approaches that have been adopted in this study are similar to others in that they are based on the familiar concepts of medical need and economic demand. Models that employ the needs-based approach typically define manpower requirements in terms of the numbers of personnel necessary to provide care to all who need treatment. Models that employ a demand-based approach define manpower requirements in terms of the numbers of personnel necessary to provide care to all who need--and will pay for--treatment.

#### **The Needs-Based Approach**

A range of models of varying complexity have employed a needs-based approach. Examples include various population-ratio models and the well-known Graduate Medical Education National Advisory Committee (GMENAC) model. The needs-based model developed in this study employs a population-ratio approach, but differs from most such applications in that it stratifies the population by age. The advantage of this approach is that it permits explicit consideration of the impact of changes in the age structure of the U.S. population on personnel requirements.

#### **The Demand-Based Approach**

The model divides the supply of personnel into groups according to the primary age group (that is, children, adults) of their patients. Age-specific manpower/population ratios are formed by relating the number of personnel in each group to the size of each associated population segment. The ratios are then adjusted, as appropriate, for any imbalances that prevail between personnel supply and requirements. Allied health personnel requirements are estimated by applying the adjusted ratios to estimates of the future size of each population segment.

#### **Demand-Based Approach**

Demand-based models tend to display much less variation than do models based on need. The models developed by BHPPr and the American Medical Association, for example, are similar in many respects. In most respects, the demand-based model developed in this study was patterned after the BHPPr model for estimation of physician manpower requirements. This approach was taken to ensure compatibility with previous and ongoing manpower requirements estimation conducted within other divisions of the Bureau.

The model begins with an examination of the utilization of services provided by allied health personnel in various types of

health-care facilities. In this model, persons utilizing these health-care services are stratified by age only--not by age, sex, and income strata. Growth rates in the utilization of health-care services within each facility type are then estimated, based on estimates of the future size of each population segment. Finally, facility-specific personnel requirements are estimated by applying these growth rates to estimates of the numbers of personnel employed in each type of facility.

### **Project Coordination**

Throughout the project, much attention has been provided regarding past modeling efforts. AOTA and American Physical Therapy Association (APTA) have participated in the process to assure that the contractor provides a useful product. The need is a set of models or methods that may be deployed by BHP's Division of Associated and Dental Health Professions, and APTA and AOTA staff in the short term and, if appropriately updated, remain useful over the long run.

Finally, this is a 12-month project to evaluate existing modeling developments, consider the feasibility of applying alternative modeling approaches to the selected professions, examine the data requirements of such modeling efforts, and evaluate the usefulness of existing data sets for manpower modeling activities. The final outcome will be a proposed methodology for the Division and the profession to prescribe when making an estimate regarding manpower requirements.

### **Summary**

A number of sources have reported that supplies of allied health personnel, including physical therapists and occupational therapists, do not meet requirements.

The preliminary results of this modeling effort indicate that personnel requirements for these professions will increase significantly within the next 20 years.

This increase in requirements, however, will not be uniform across all patient age groups, rather it will be particularly dramatic among personnel treating adults and the elderly.

Over the years, a number of studies of requirements have developed and can be classified under two general headings: (1) needs-based methodology and (2) demand-based methodologies. Several methods for estimating manpower requirements have been investigated, and three approaches have been proposed and are being reviewed: the segmented population-ratio model, the BHP (demand-based) model, and the facility-oriented model.

## Session E: Getting Forecasting Used

Chair: Dan Gaske<sup>1</sup>

### Improving the Utilization of Forecasts: Some Helpful Principles

Dan Gaske

**Abstract.** *An important role of the forecaster/modeler is to ensure that his or her forecasts are used by the organization. This session will provide remarks and discussion by experienced forecasters and users of forecasts as to practical steps and techniques for increasing the effectiveness and use of forecasts for the organization.*

Because of the intense resource requirements of forecasting methodologies, especially of methodologist and computer resources, it is important from a cost-benefit calculation that once a decision to construct and maintain a forecasting or other type of methodology is made, that the forecaster and organization at large invest sufficient effort into full utilization of the methodology. Often these steps do not occur, with the result of an underutilized methodology, a frustrated methodologist, and cynical potential nonmethodologist users of the methodology's results. This presentation outlines frequent origins of the underutilization of methodologies and provides several simple-to-implement, but often overlooked, principles that will increase the utilization of forecasting results by the organization.

#### The Problem

Methodological results tend to be underutilized for two basic reasons: they are perceived to require more time than the potential consumers believe they can give to incorporating the forecasts into their products and they are perceived to be too complex to effectively add to the potential consumers' product.

#### Lack of Time

Most users of forecasts, be they analysts, staffers, or policy principals, are under ongoing, daily time constraints. They have numerous meetings to attend, policy papers to prepare, daily publications to provide input to, and large ranges of issues to monitor. In these circumstances, their initial reaction to a proposed methodological input that requires time to incorporate into their product will be to ignore it.

#### Lack of Understanding

A second key drag on the use of methodologies is a less-than-complete, or perhaps even less-than-comfortable, understanding by the potential consumer of methodologies, both in general and in the case of the particular methodology that exists to help him or her. Often a noneconomist, frequently a nonmethodologist, these

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<sup>1</sup>Central Intelligence Agency.

individuals understandably are reluctant to embrace and use a methodology that is opaque to them in its structure, assumptions, and results.

## **The Principles**

Since many of the causes of underutilization of methodologies stem from a perception on the part of the potential consumer that he or she does not have sufficient time or understanding to use the methodological results, the principles, not surprisingly, are aimed at removing or reducing those perceptions.

### Principle 1

Become Educated About Your Potential Consumers' Needs. To convince potential consumers to make use of forecasts, it is important for the methodologist to realize he or she is providing a personalized service and not a commodity. Therefore, it is incumbent upon the methodologist to find out the general needs and objectives of each potential consumer and then to actively think about how the methodological results can fit into those needs. If the organization has a research program or planning calendar, these documents can be effectively utilized to hook methodologies into broad organization objectives.

### Principle 2

Educate the Potential Consumer About the Methodology. Once the methodologist obtains a detailed awareness of the general needs and objectives of potential consumers, the second step is to make the consumers aware of the potential of the methodology to contribute to those objectives. The consumer as a rule will not come to the methodologist; he or she can do their job without methodologies. Moreover, this education must be consumer-specific. It is not a good idea to provide the consumer with a chapter out of a textbook on the uses of the methodology; the consumer needs to be guided to understand the methodology in the context of his or her needs.

Several ways exist to educate/convince the consumer about the usefulness of the methodology. A basic one is to obtain some of the potential consumer's time and provide a brief, simple statement of the structure of the methodology and how the results of the methodology would be helpful to the consumer's needs. A second way is to provide the consumer with examples of methodology results that address the needs of the consumer.

### Principle 3

Make Sure that Presented Methodological Results Can Be Used As-Is By the Potential Consumer. That is, do not give the potential consumer a computer printout of the results of the methodology; he or she will not understand the results and will not have time to construct a usable presentation. Instead, with what you understand about the objectives and needs of the consumer, go through the results and prepare an appropriate table or graph

that provides the key results of the application of the methodology.

#### Principle 4

Find Ways Methodological Results Can Be Used Alone. Once a methodology has been constructed and is in an operational mode, it can generally be used to create potentially useful results at a faster rate than consumers will have specific uses for them. Therefore, it is a good idea to find outlets for these results that are not dependent on a linkup with a particular objective or activity of the nonmethodological consumer. These stand-alone outputs must, of course, remain relevant and germane to the general needs and objectives of the organization but need not be directly linked to nonmethodological outputs. They must, however, remain presentationally in a format that the nonmethodological part of the organization is comfortable with, that is, brief, straightforward and nonjargony--as the nonmethodologists in the organization generally will control what is and is not released.

Several examples can be used to illustrate this fourth, and final, principle. If, for example, your organization has a regular publication devoted to issues on which a methodological approach can be brought to bear, prepare items for this publication which explicitly use the methodology to address some aspect of that issue--again, in a brief, straightforward, and nonjargony fashion. In one case, use was made of an econometric model of a foreign country to examine causes of increases in imports, and the results were presented in an economics issues periodical as an examination of the issue using an econometrics approach. A related approach is to prepare brief papers that deal with an issue from an explicitly methodological approach. It is important to be clear about the use of a methodology in obtaining the results, as that up-frontness, in the perceptions of the nonmethodologists, clears them from having made a judgment with which they may or may not be comfortable.

#### **Concluding Remarks**

Getting methodology used regularly in policy- and action-oriented government organizations is not easy due to the nature of methodologies and their results, complex and slow to obtain, often being in opposition to the desires of the nonmethodological parts of the organization. It is not impossible, however, and the application of the four principles can, and already has in some organizations, lead to dramatically increased rates of utilization of methodologies and their results.

# **Improving Utilization of Forecasts<sup>1</sup>**

Beth S. Lewycky<sup>2</sup>

- o Background: Role of the Methodology Center
- o Marketing our service
  - Clients are customers
  - Marketing techniques
- o Competitive markets
  - For forecasters
  - For our clients

## **Role of Methodology Center**

- o Methodology Center's functions
  - In-house consulting group
  - Provides methodological support
- o Our customer's product
  - Finished intelligence targeted for policymakers
- o Methodology Center's Product
  - Analysis based on models and other quantitative methods
  - Forecasts are intermediate input into policy decisionmaking

## **Marketing Our Service**

- o Clients are customers
  - Identify customer's needs
    - How does he use our forecasts?
  - Tailor product to his needs
    - Answer his questions
    - Don't force product on him
- o Meeting with the client
  - Meet on his turf
    - Better understanding of his work environment
  - Talk in his language
    - No jargon
    - Interpret analysis
    - Explain assumptions
  - Develop his confidence
    - Forecasting is an intangible product
    - Develop track record
    - Involve the client
  - Be responsive
    - Listen when he has problems with your analysis
    - Do some of his work for him

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<sup>1</sup>Editor's Note: The following is the text of a series of briefing slides.

<sup>2</sup>Central Intelligence Agency.

## **Competitive Markets**

- o For forecasters
  - Alternative forecasts
  - Not using any forecast
- o For our client
  - Competing analysis
- o Competition breeds demand for forecasts
  - Differentiate the product
- o Expand product line

## Session F: Forecasting Evaluation and Case Study Analysis

Chair: Paul R. Campbell<sup>1</sup>

### Evaluation of Recent State Population Projections

Paul R. Campbell

**Abstract.** *To evaluate two recent sets of State population projections prepared at the U.S. Bureau of the Census, we compared the projections totals for 1987 to 1989 with the independent estimates developed. We use the mean absolute percent error (MAPE) to summarize the results of the comparisons for each series. This presentation includes identifying regular patterns in the regional distribution of the MAPE's and anomalies.*

State population projections are used as a factor in many government and private sector decisions. Consequently, the practitioner using population projections is faced with the typical question: How accurate are these projections at forecasting the future? Without a doubt, the most crucial test of the worthiness of a set of State population projections is to evaluate recent State population projections against estimates.

This presentation is a shorter version of a more detailed evaluation of State population projections Signe Wetrogan and I prepared for the 1990 Population Association of America meetings. The more detailed presentation covers the evaluation of projections in six different reports that go back to the mid-1960's. In this presentation, I will cover only the last two reports published by the Bureau of the Census (1990a and 1988) (1,4).<sup>2</sup>

The State projections in report No. 1053 were developed using an annual cohort-component model with 1988 as the base year. Three alternative series of projections were created based upon annual State-to-State migration data covering 1975 to 1988. Series A assumes a continuation of a modified linear trend in migration. Series B is the average of the migration rates from 1975 to 1988. Series C is the average of the more recent migration rates from 1985 to 1988.<sup>3</sup>

The projection series in report 1017 was also developed using an annual cohort-component model with 1986 as the base year. The projection of migration was based on annual State-to-State migration data covering 1975 to 1986 and assumed a continuation of a modified linear trend in these rates.

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<sup>1</sup>Bureau of the Census, U.S. Department of Commerce.

<sup>2</sup>Underscored numbers in parentheses refer to sources listed in References.

<sup>3</sup>An additional set of projections are provided for illustrative purposes. Series D, assumes zero net internal migration.

To evaluate the projections, we compared the projections of total State population for midyear 1987, 1988, and 1989 with the independent estimates developed for those dates at the Census Bureau. To summarize the results of the comparisons for each series, we used the mean absolute percent error (or MAPE); where:

$$\text{MAPE} = 100/n * \sum [ |(\text{projection} - \text{estimate})| / \text{estimate} ]$$

We developed the overall MAPE's for the United States where n equals 51 and for each census region where n equals the number of States in each region.

Tables 1 and 2 present the results of these comparisons. In general, projections for Series A and C in report No. 1053 and the projection in report No. 1017 appear to track close to the actual data. For all these series, the mean absolute percent errors were close to 0.5 percent per year.

For each of the three projections series developed in 1988, the MAPE's calculated for the West appear to be larger than any other region. The MAPE's calculated for the Midwest are consistently the smallest.

Table 1--Tracking of series P-25, No. 1053: 1989

Base-year: 1988	Series A	Series B	Series C
	Mean absolute percent error 1/		
Total (N = 51)	0.4	0.7	0.4
Northeast (N = 9)	.3	.5	.4
Midwest (N = 12)	.2	.3	.3
South (N = 17)	.3	.7	.3
West (N = 13)	.6	1.1	.7

1/ Mean absolute percent error (MAPE) based on State data reported in the Bureau of the Census (1,2).

Table 2--Tracking of series P-25, No. 1017: 1987 to 1989

Base-year: 1986	1987, 1 year ahead	1988, 2 years ahead	1989, 3 years ahead
	Mean absolute percent error 1/		
Total (N = 51)	0.5	1.1	1.6
Northeast (N = 9)	.2	.7	1.1
Midwest (N = 12)	.2	.6	1.0
South (N = 17)	.4	.8	1.2
West (N = 13)	1.1	2.1	3.0

1/ Mean absolute percent error (MAPE) based on State data reported in the Bureau of the Census (2,4).

For the 3-year ahead projection, the MAPE for report No. 1017 is 1.6 percent. Furthermore, for both the 1-year and 3-year ahead evaluations, there appear to be some regular patterns in the regional distribution of the MAPE's. The West and South tend to have large MAPE's, while the Midwest has the smallest.

Table 3 provides a comparison of the State and regional projections and estimates in 1989. In general, more States are underprojected or lower than the population estimates. In both the 1053 and 1017 projection series, Nevada was an outlier where we appear to underproject the population significantly. Other consistent outliers are Wyoming, Colorado, and Utah where we appear to overproject their population, as shown in figures 1 to 4.

Neither set of projections does a good job of projecting turnarounds. Many of the outliers shown for P-25, No. 1017 are turnarounds. As an example, after several years of population loss, Iowa's downward slide appears to have reversed.

In an earlier analysis, we found that the Census Bureau's latest sets of projections (No. 1017 and Series A and C of No. 1053) appear to be tracking better than any of the previous sets of projections. However, even for many of the earlier sets, the projections appear to be tracking reasonably well. For the projections prepared in 1965 (5), the MAPE's are 9 percent for the 15-year ahead projection and about 11 percent for the 20-year ahead projection.

In conclusion, the results show that our projections closely match the population estimates. As expected, the errors in our projections increase with the projection horizon. For both of these series, the mean absolute percent error appears to be less than 0.5 percent per year. For the 3-year ahead projection, the MAPE for P-25, No. 1017 is 1.6 percent. We also show that the greatest error is in the West.

This evaluation is an attempt to compare published State population estimates and projections produced in the Federal sector. This presentation does not attempt to deal with methodological inconsistencies that may exist for the State estimates and projections. Some share of the error in the State population projections may be due to the low national population projections and to technical differences from the State population estimates (for details of how estimates are derived see 2, p. 2). However, these are minor factors compared with the mean absolute percent error.<sup>4</sup>

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<sup>4</sup>MAPE's calculated using State projections (4) adjusted to the national estimates show little variation from those reported above.

Table 3--1989 Estimated population and percent difference between the 1989 estimated population and the 1989 projected population from selected reports

Region, division, and State	Estimate pop. 1989 (in 1,000's)	Series in No. 1053				No. 1017
		A	B	C	D	
		Percent Difference 1/				
United States	248,239	-.2	-.4	-.4	-.4	-.4
Northeast	50,772	-.2	-.6	-.3	.4	-1.4
New England	13,047	0	-.5	-.1	-.2	-.8
Middle Atlantic	37,726	-.2	-.6	-.4	.6	-1.6
Midwest	60,148	-.1	-.4	-.3	.5	-1.5
East North Central	42,298	-.1	-.5	-.2	.5	-1.4
West North Central	17,851	-.1	-.2	-.4	.3	-1.8
South	85,523	0	.2	.1	-.5	1.6
South Atlantic	43,115	.1	-.9	0	-2.1	-.3
East South Central	15,406	.3	.7	.7	.5	1.3
West South Central	27,002	-.2	1.9	-.1	1.4	4.9
West	51,796	-.8	-1.3	-1.4	-2.0	-1.5
Mountain	13,513	-.2	.7	-.1	-.6	3.6
Pacific	38,283	-1.0	-2.0	-1.9	-2.5	-3.3
New England:						
Maine	1,222	-.1	-1.0	-.5	-1.8	-3.1
New Hampshire	1,107	.5	-.8	1.3	-2.7	1.6
Vermont	567	-.5	-2.0	-1.3	-2.1	-3.5
Massachusetts	5,913	-.2	-.7	-.6	.2	-1.7
Rhode Island	998	-.3	-.7	-.1	0	-.4
Connecticut	3,239	.3	.7	.8	.7	1.1
Middle Atlantic:						
New York	17,950	-.4	-.9	-.9	1.0	-2.1
New Jersey	7,736	.3	.5	.8	.8	2.4
Pennsylvania	12,040	-.1	-.8	-.5	-.1	-3.3
East North Central:						
Ohio	10,907	-.2	-.9	-.5	.1	-2.2
Indiana	5,593	-.1	-.7	-.3	-.1	-1.8
Illinois	11,658	-.1	-.4	-.3	1.0	-1.0
Michigan	9,273	-.1	-.5	.2	.6	-.2
Wisconsin	4,867	.2	.2	.1	.8	-2.6
West North Central:						
Minnesota	4,353	-.2	-.9	-.7	-.6	-2.5
Iowa	2,840	-.5	-.5	-1.4	.8	-4.2
Missouri	5,159	.3	.3	.6	.4	.2
North Dakota	660	.4	3.0	.5	3.6	1.2
South Dakota	715	-.1	-.1	-.5	.8	-2.0
Nebraska	1,611	-.5	-.4	-1.2	.4	-2.6
Kansas	2,513	-.1	-.2	-.5	.1	-2.2

See notes at end of table

continued--

Table 3--1989 Estimated population and percent difference between the 1989 estimated population and the 1989 projected population from selected reports--continued

Region, division, and State	Estimate pop. 1989 (in 1,000's)	Series in No. 1053				No. 1017
		A	B	C	D	
		Percent Difference				
South Atlantic:						
Delaware	673	-.3	-1.3	-.5	-1.2	-2.2
Maryland	4,694	0	-.7	-.1	-.9	-.6
District of Columbia	604	.7	1.2	1.0	2.8	1.8
Virginia	6,098	.4	-.3	.2	-.6	-.5
West Virginia	1,857	.1	1.1	.2	1.5	.8
North Carolina	6,571	.2	-.3	.1	-.8	.5
South Carolina	3,512	.1	-.1	0	-.5	-.1
Georgia	6,436	.5	-.1	.5	-.7	1.4
Florida	12,671	-.3	-1.1	-.5	-2.2	-1.1
East South Central:						
Kentucky	3,727	.3	.4	.2	.6	.4
Tennessee	4,940	.3	0	.3	-.4	-.1
Alabama	4,118	.4	.4	.5	.2	.8
Mississippi	2,621	.5	.7	.5	.8	2.3
West South Central:						
Arkansas	2,406	.1	.3	.2	.1	.3
Louisiana	4,382	.1	1.5	.2	1.6	2.9
Oklahoma	3,224	-.4	1.4	-.3	1.1	1.9
Texas	16,991	-.3	.8	-.1	.4	2.7
Mountain:						
Montana	806	-.7	.7	-.8	.4	.2
Idaho	1,014	-.6	.7	-.7	.1	-.1
Wyoming	475	-.3	3.2	-.4	2.3	5.9
Colorado	3,317	-.1	1.1	.2	.5	2.3
New Mexico	1,528	-.5	.3	-.3	-.5	4.4
Arizona	3,556	.5	-.2	.7	-1.1	2.6
Utah	1,707	.1	1.0	.3	1.2	2.5
Nevada	1,111	-1.6	-2.9	-2.1	-4.2	-5.6
Pacific:						
Washington	4,761	-.8	-.8	-.9	-1.6	-3.1
Oregon	2,820	-.8	-.6	-1.0	-1.2	-2.5
California	29,063	-1.0	-1.2	-1.0	-1.2	-1.6
Alaska	527	-.9	1.7	-.7	.6	7.2
Hawaii	1,112	-.4	-.4	-.5	-1.4	.8

1/ Percent difference obtained from populations as follows:

$$[(1989 \text{ projection} - 1989 \text{ estimate}) / 1989 \text{ estimate}] * 100.$$

Projections and estimates are reported in the Bureau of the Census (1990a, 1990b, and 1988).

Figure 1

## PROJECTIONS VS. ESTIMATES: 1989

Source: P-25, No. 1053 - Series A



Figure 2

## PROJECTIONS VS. ESTIMATES: 1989

Source: P-25, No. 1053 - Series B

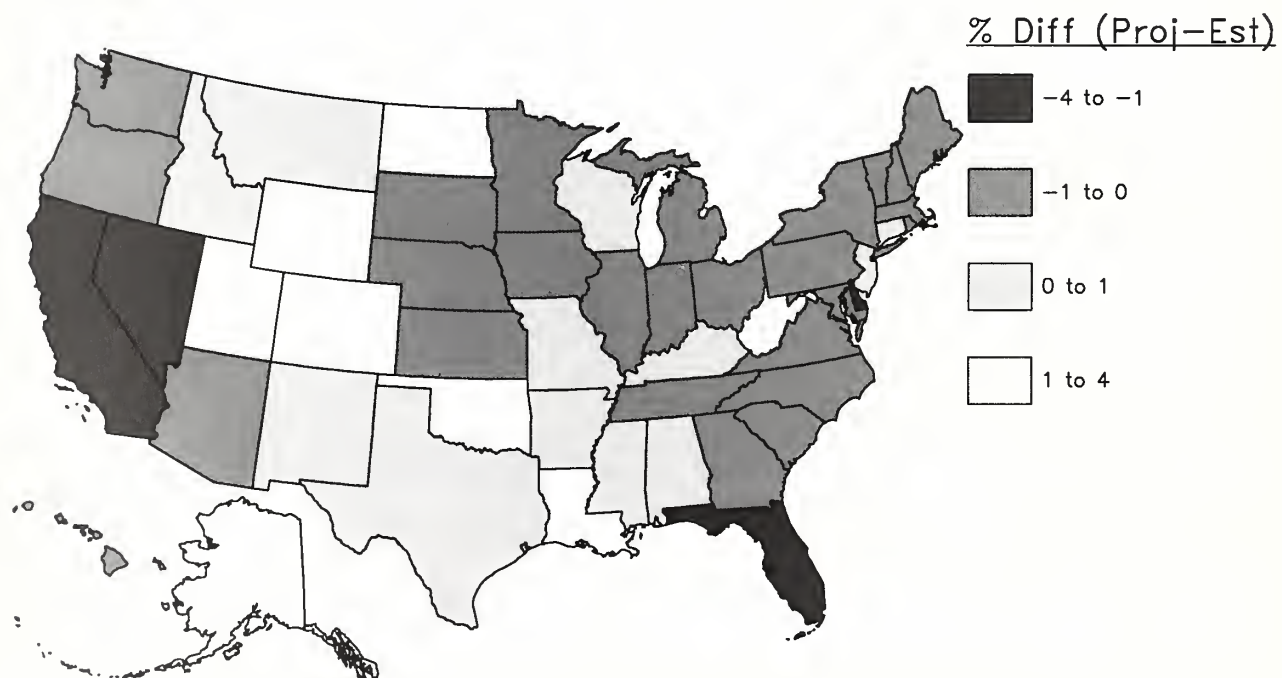


Figure 3

## PROJECTIONS VS. ESTIMATES: 1989

Source: P-25, No. 1053 – Series C

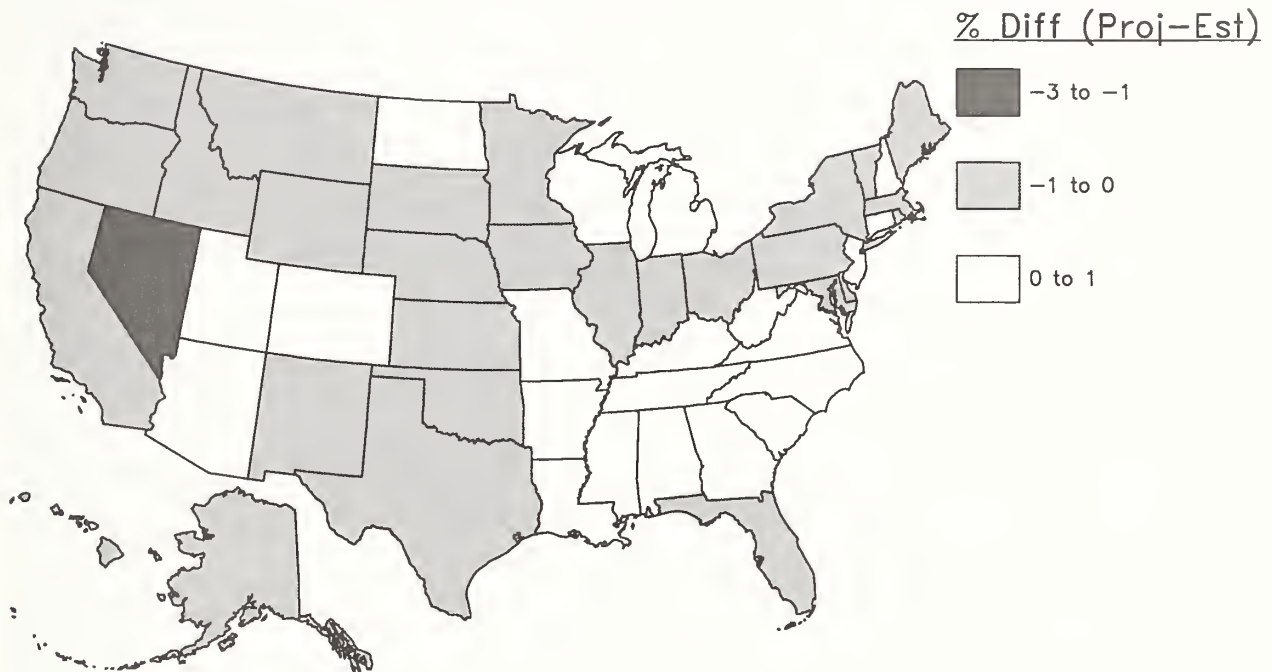
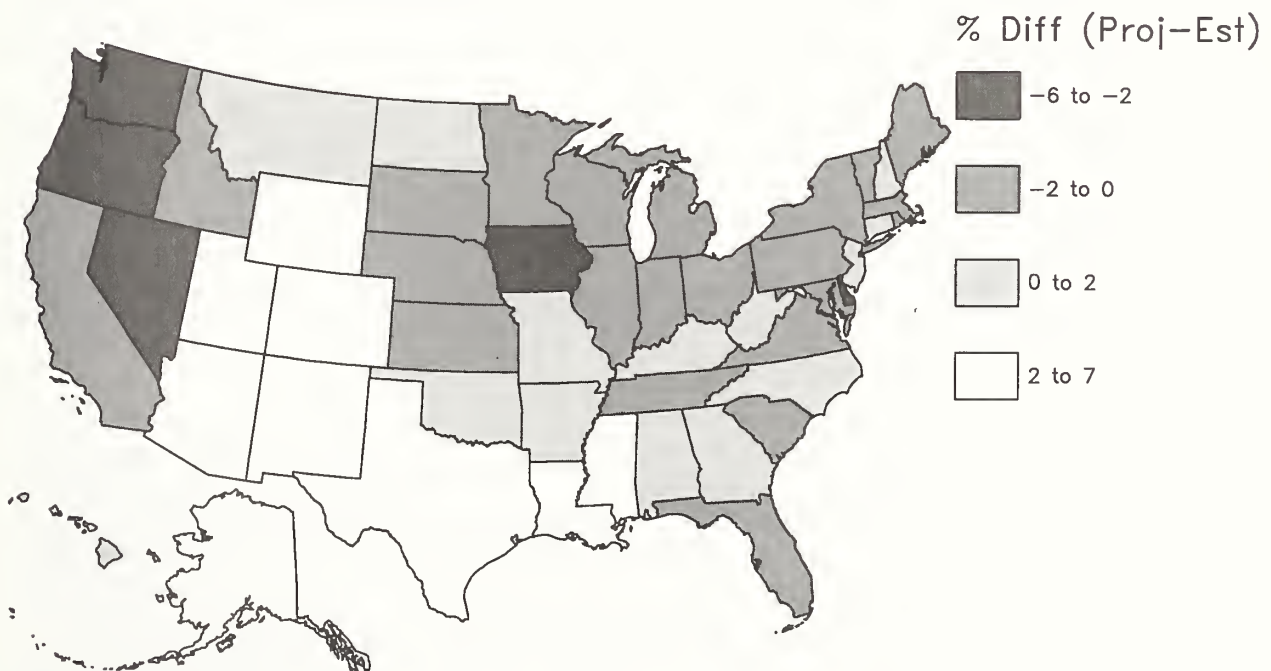


Figure 4

## PROJECTIONS VS. ESTIMATES: 1989

Source: P-25, No. 1017



What does this evaluation tell us about the reasonableness of our projections in the future? For States with relatively consistent growth patterns across time, we will probably continue to do reasonably well. For the remainder of the States, those that have changing patterns of population growth, we will need to develop alternative models which project turnarounds in growth or place confidence intervals on the projections.

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## What (More) Can We Learn from Macroeconomic Forecast Evaluations?

H. O. Stekler<sup>1</sup>

**Abstract.** *There have been many studies which have evaluated forecasts, but few have attempted to determine why specific types of prediction errors occur. Because most forecasters do not record the procedures they use, one must infer this information from the forecasts themselves. This presentation focuses on how forecasters might have generated the forecasts so that the observed errors were obtained. We must understand this process if we are to improve our forecasting performance.*

There have been myriad macroeconomic evaluation papers and they have asked innumerable questions about the quality of economic forecasts. Some of these questions were listed by Stekler (27)<sup>2</sup> and include the following: (1) How good is a method or forecaster, (2) Do the forecasts show systematic errors? (3) Are all forecasters equally good? (4) Is a method or forecaster better than average? (5) Is a particular method or forecaster better than another? (6) Does a forecast contain information not in another? and (7) Does a forecaster produce estimates that are useful?

Rather than focus on all those issues, this presentation focuses on some unanswered problems arising from the second of the aforementioned questions: systematic errors. The evaluations indicate that there are some systematic forecasting errors. The next step in any evaluative procedure would be to determine why these errors occurred. Sometimes it is possible to do that. For example, if a forecaster used a formal model and maintained a record of all the assumptions and adjustments employed, it would be possible to determine whether the data were revised, the model well specified, the exogenous variables predicted accurately, or the adjustments inaccurate. Even in this case, we would still like to know why the inaccurate judgmental adjustments occurred (30).

However, most of the time we do not have the opportunity of using a well-documented model to determine the source of the errors. Most forecasters do not record the procedures which they utilized or the reasons why the forecasts were adjusted as they were. In such cases, it is necessary to infer this information from the only available data: the forecasts and the errors. This technique of modeling a prediction process has been termed

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<sup>1</sup>Industrial College of the Armed Forces, National Defense University, U.S. Department of Defense. The opinions expressed in this presentation are those of the author and are not the views of the National Defense University or the Department of Defense.

<sup>2</sup>Underscored numbers in parentheses refer to sources listed in References.

"bootstrapping" (4) and has been applied in a number of areas (11,15,20).

Thus the task of this presentation is, given the forecasts and their associated errors, to determine, if possible, how the forecasts were generated and to discover the step(s) in this process which may have produced the errors. This process of reconstructing a forecast process and determining why the errors occurred is akin to reconstructing the cause of an airplane accident from the available evidence.

This presentation does not examine all the steps that are involved in generating forecasts (and the associated errors). For example, it does not consider the role that might be played by an improperly specified formal model. The procedures for evaluating formal models are well established. Nor is the role that data errors or revisions contributed to the errors of formal models considered. However, we shall examine some of the forecast procedures, and interpretations which come under the heading of judgmental factors. Two issues are examined in some detail: (1) why underestimates occur, and (2) the prediction process in the neighborhood of cyclical turning points.

### **Underestimates of Change**

#### Optimal Predictor or Biases?

Many evaluations of economic forecasts indicated that the predictions underestimated the changes that occurred. Anderson (3) and Zarnowitz (33) showed that underestimates are typical of the types of forecast errors which were observed for periods of expansion. The inflation of the 1970's was also underestimated (34). There are several possible explanations for these underestimates. The first suggests that this phenomenon is the natural result of processes that generate optimal forecasts. The second explanation focuses on the anchoring and conservatism tendencies of judgmental procedures (4).

The first explanation indicates that the underestimates of changes must result from the fact (?) that the variances of the predicted changes are smaller than the variances of the actual changes. Under the assumption of optimal forecasts, it has been demonstrated that the smaller variances of the predictions relative to those of the actual values will yield underestimates (12,13,19,21). There are a number of reasons why this explanation of underestimates may not be satisfactory. These analyses assume that predictions are based only on past and current information and that no adjustments are made to the optimal predictor. However, most econometricians use judgment in preparing forecasts and adjust these optimal predictions to take account of factors which had not been incorporated in the model (32).

Moreover, the historical forecasting records demonstrate that the variances of the predicted changes may, in fact, sometimes be larger than those of the actual changes (2,16,26). Thus, the

observed ex ante underestimates must, at least in part, be caused by factors other than the stated assumptions about the variances of predicted and actual changes relative to the variances of the actual changes.

An alternative explanation is that these errors might be the result of anchoring or conservatism biases which have been found in judgmental forecasts. These biases have been defined as predicting by anchoring on a previous value and then adjusting for perceived changes, but failing to adequately revise the estimates based on the new data (14).

It might be possible to distinguish between these causes of underestimates--those which are avoidable as a result of biases and those which are unavoidable resulting from the use of optimal predictors. Assume that forecasters apply more judgmental adjustments to the short-term predictions of a model than they apply to the long-term forecasts. Then it is likely that the ratio of the variability of predicted changes to that of actual changes would decline with the length of the forecast period. Thus, one could hypothesize that the shorter term underestimates are the result of anchoring, while the more distant errors might be explained by the characteristics of optimal predictors.

Ash and Smyth demonstrated that the ratios of the variances did behave as postulated (5). This suggests that extrapolative techniques that have the characteristics of optimal predictors were more extensively used for the more distant projections. (This lends some credence to the view that the underestimates of short-term predictions may be the result of biases which do not effectively use new information.)

#### Forecast Revisions with New Information

It is also possible that these underestimates can result from the way that forecast revisions are made. Mincer first tested alternative models to explain the revision process, that is, the way in which new information is used (18). He concluded that the forecast for the  $t^{\text{th}}$  period made in  $t-1$  is revised from the  $t^{\text{th}}$  period forecast made in  $t-2$  using the information obtained in  $t-1$ . Stekler suggested that the forecast revision process is at least partially responsible for perpetuating the underestimates from period to period (26). He used a model similar to Mincer's and indicated that there were three reasons why changes could be underestimated. First, the forecasters could have displayed perennial pessimism (6). However, the forecasts in Stekler's sample did not exhibit this characteristic. Alternatively, the original estimate for the current quarter might have been an underestimate, or finally, the revision process itself might have contributed to the underestimates.

The results of that study indicated that both the original and revised predictions for the current quarter were underestimates. When current quarter predictions were revised, these estimates were changed in the direction of the actual changes and the

number of underestimates was reduced. This indicates that data referring to the current quarter were interpreted correctly.

However, forecast revisions for the  $t+1$  period were not successful. The revised predictions were not closer to the actual changes than were the original forecasts. This suggests that the revision process, by failing to adjust adequately for the new information, contributed to the underestimates of the  $t+1$  forecasts. There are several possible explanations of this tendency for forecast revisions to perpetuate the observed underestimates.

Stekler's model provided one conjecture of how it is possible to improve current quarter forecasts without improving the quality of subsequent period predictions. Stekler conjectured that the forecasters might have attempted to preserve the magnitude of the change that was originally forecast. This is consistent with the view that current quarter revisions should lead to changes in the next quarter's estimates only if the revision can be traced to an event that reverses itself. This is another form of anchoring which implies that there was some cost associated with changing the forecast for next period solely on the basis of having additional data for the current period.

Instead of attributing the phenomenon to anchoring and the costs of changing forecasts, a complementary way of explaining these errors in revising forecasts is that the extrapolative content of the revised data was not completely exploited (17). In fact, Corrado and Greene suggest that judgmental revisions for subsequent periods had not taken into account all the implications of current quarter changes (7). Thus, the available evidence suggests that the observed underestimates might partially be attributable to the failure to correctly exploit the information available in new data.

### Predictions at Turning Points

The issues that have been examined so far involved procedures for making quantitative forecasts. We now turn to a different topic, the ability to recognize and predict turning points which some forecasters have classified as changes in regimes. Their ability to predict cyclical peaks has been recognized as one of the most serious failings of the quantitative forecasts, and it has been argued that the use of quantitative forecasting techniques may generate turning point errors (21).

Since the process of detecting changes in regimes is different from making quantitative predictions, forecasting methods designed exclusively to recognize and predict turning points have been developed. These alternative methods, specifically designed for predicting turning points, include individual leading series, indexes of leading series, and rate of change methods. Recently, more sophisticated procedures for detecting switches in regimes have been suggested (20,31). Studies have demonstrated that, in theory, the newer techniques would have predicted the turns of the 1974-75 and 1981-82 recessions (8,20).

Just as the procedures for forecasting turning points are different from the techniques involved in making quantitative forecasts, analyses of economists' general failure to predict cyclical peaks should use a different approach. However, hypotheses about the forecasting mechanisms that would reproduce the observed results have not been fully developed.

For example, Fels and Hinshaw provided a scoring system to reflect the outlook implicit in statements made by business analysts and the Open Market Committee, and showed that as the date of a cyclical turn approached and passed, forecasters' certainty that it would occur increased (10). However, there is no direct comparison of movements in these scores with changes in the objective contemporaneous data, nor is a hypothesis about the forecasting mechanism advanced.

Stekler advanced the hypothesis that forecasters used Bayesian procedures in predicting turns (24). This assumed that forecasters begin with subjective probabilities about the likelihood of a turn, and as new information becomes available, these probabilities are revised in a Bayesian manner. That study inferred that a forecaster should have had no difficulty in recognizing the 1957 and 1960 recessions, if this approach had been used and the prior probability had been greater than zero.

The failure to at least recognize these recessions was attributed to the forecasters' priors (for a cyclical turn) which were zero, which meant that they did not expect a recession and were surprised by its occurrence. Support for this hypothesis is presented by Eckstein, who argued that the upper cyclical turn is often associated with credit crunches, and prior to "the crunches, there is no reason to look for the turning point" (9).

This interpretation is consistent with evidence that cyclical upturns are recognized and sometimes forecast in advance. The explanation is that forecasters expect the implemented public policies to produce cyclical upturns. Moreover, an analysis of the 1969-70 price forecasts provides a similarly striking asymmetry. In that time period, the inferred prior probabilities that inflation would be controlled quickly were very high (22,25).

No additional research has been undertaken to explain why turning point errors have occurred, but there has been a recognition of the necessity of avoiding false predictions. That is one explanation of the heuristic rule that the index of leveling series must decline three consecutive months before a peak is predicted. Moreover, Zarnowitz and Moore indicate that the costs of predicting false turns may be substantial, for they suggest that sequential signals from two series be used to predict turns, thus providing confirmation of early (and possibly erroneous) signals (35). Thus any framework which is intended to explain why turning point errors occurred must take into account the costs and benefits associated with making both current predictions and the two types of errors: failing to predict a turn and calling one that does not occur.

## The Use of Information in the Forecasting Process, with Suggestions for Improvements

In analyzing why forecast errors occur, one theme has dominated the entire discussion--the way information is used in generating economic predictions. The evidence indicates that forecasters are able to obtain, interpret, and use current information to improve the quality of their current quarter estimates. Yet they cannot use the revisions in the current quarter predictions to improve the quality of subsequent quarter projections. This deterioration in the ability to process information must eventually be explained.

Some explanation might be obtained from the cognitive psychology literature which provides insights about the way individuals make decisions (14,29). Individuals have a limited ability to process information and, moreover, display significant search and processing biases, with the use of heuristics heavily influencing the decision process. Yet little attention has been paid to the heuristics that economists (might) use in preparing forecasts. Among the few studies that examined forecasters' heuristics were the papers of Acito and Olshavsky (1), which indicated that forecasters tend to reason by analogy, and those of Fildes (11) which went even further and indicated that the forecasters did not understand the dynamics of the construction industry.

The cognitive psychology literature also provides some suggestions which might be helpful in improving the quality of forecasts. The literature indicates that individuals will process information better if there is frequent feedback between action and outcome. This implies that there should be frequent evaluations of forecasts and explanations of why forecast errors were made (4). This procedure is utilized in the field of meteorology and the results show that weather forecasts are well calibrated. However, weather forecasters have a base (average previous climate) with which their forecasts can be compared. Such a base is not available to economists, and we must construct our own standards. A second suggestion is that discussions with other forecasters might improve the processing of information. However, there is evidence that forecasters do, in fact, compare predictions and this might account for consensus-type forecasts.

The final suggestion comes from some of the empirical results cited above. The evidence indicates that forecasters are able to interpret past data well and thus can make a correct assessment of the current state of the economy. These estimates of the current situation can then be used (optimally) to provide additional factors for an econometric model (7). In turn, the forecasts of the econometric model can then become a scenario against which new incoming data can be compared. If the new data are not consistent with the scenario, the forecast for all (not just the next) quarter(s) should be revised. If data are compared against a scenario, it may be possible to avoid excessive focus on the current situation and the anchoring outcomes which have been observed.

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# Development of the Census Bureau Migration Model: A Case Study of Forecasting in the Federal Sector

Larry Sink<sup>1</sup>

**Abstract.** *The Bureau of the Census has developed a migration model for its State population projections. This presentation emphasizes the aspects of this development that pertain to the particular problems encountered by those producing forecasts in the Federal sector. Examples illustrate the differences between forecasting in the Federal sector and forecasting in academia or business, the role of politics in the production of Federal forecasts, and ways in which our unique situation as Federal forecasters can be used to our advantage.*

This presentation is concerned with the particular problems faced by those producing forecasts in the Federal sector. These problems are discussed here in the context of the Census Bureau's experience in projecting interstate migration. While it is not the purpose of this presentation to discuss forecasting techniques or migration analysis per se, it is necessary to explain something of what we do in order to show how these problems present themselves in our situation. It is hoped that the examples drawn from our experience may provide useful lessons for others producing forecasts in the Federal sector.

In general, professional discussions about forecasting tend to be dominated by matters that are of greatest concern to academic forecasters, such as the theoretical properties of models and the nature and significance of inferences that can be drawn from forecasts. To illustrate, for most forecasting audiences, I would need to begin by pointing out that the Census Bureau is engaged in projection, not forecasting, and then say something about the difference between the two, even though this distinction is not important for the purposes of this presentation. Because Federal forecasts are produced with goals and constraints much different than those found in academia, academic criteria do not necessarily offer the most effective guidelines for the improvement of Federal forecasts. Thus, before discussing specific examples, it is necessary to explain the differences between forecasting in the Federal sector and elsewhere, and the effect of these differences on the problems encountered by those producing forecasts in the Federal sector.

The basic reason for the differences just mentioned is that only very short-term forecasts are evaluated by their performance. Since forecasts are usually evaluated well before there has been a chance to see how their predictions turn out, the success or failure of a forecast is a matter of audience reaction. In academia, for example, the forecast audience consists of other academics, who tend to judge forecasts by the agreement of the assumptions and methods with theory and by the relevance of the results to current theoretical issues. Forecasters in the

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<sup>1</sup>Bureau of the Census, U.S. Department of Commerce.

business sector, on the other hand, are generally not required to disclose their methods, and the audience for their forecasts is usually more concerned with timeliness and ease of use than with theoretical issues. Federal forecasters tend to find themselves caught between these two audiences, with some requiring timeliness and ease of use while others insist on adherence to theoretical principle. This is made more difficult by the facts that while academic forecasters may decide not to work on a project if the requirements of theory cannot be met, Federal forecasters have no such option, and unlike business forecasters, Federal forecasters must submit their methods for public scrutiny.

What makes the problems of Federal forecasters different from those of forecasters in other sectors is the difference of the relationship between Federal forecasters and their audience. Federal forecasts are produced to fill some public need, and the results of these forecasts are frequently perceived as having policy implications. Thus, there is a segment of the public whose interest in these projections lies not in their accuracy or theoretical correctness but on whether or not they perceive the policy implications to be favorable. Of course, what is a favorable implication for one group can be unfavorable for some other group. As a result, there is always likely to be a segment of the public with a motivation for criticizing any Federal forecast perceived as having policy implications.

There has always been a considerable reluctance among Federal forecasters to discuss the political aspect of their work, perhaps due at least in part to the tendency of academic considerations to dominate discussions of forecasting. Academics never acknowledge any role for politics in forecasting, so we feel we shouldn't either. However, to refuse to acknowledge this problem is to place ourselves at its mercy. Most importantly, a careful consideration of the problem will reveal that it can be turned to our advantage.

It would be a sad situation if our projections had no policy implications, or if they had such implications and were ignored. The fact that our work may have impact on future public policy serves to increase public interest in what we do. And while we must not forget that good forecasts may receive criticism from people who do not like their implications, we should also remember that politically motivated criticism is not necessarily invalid. In fact, political interest may provide the motivation for uncovering legitimate methodological errors. Criticism on purely political grounds is likely to be dismissed out of hand; in order to be effective, criticism must at least appear to be aimed at improving the forecast. Thus, the task for the Federal forecaster is to ignore the motivation of the criticism and attempt to marshall it into a force for constructive change, while keeping in mind that Federal forecasts will always be subject to criticism regardless of how well they are done.

With these general points established, we may now turn our attention to specific examples. The Census Bureau organized the

Federal State Cooperative Program for Population Projections (co-op) to serve as a forum for the exchange of ideas on population projection between the Census Bureau's Population Projections Branch and representatives of State agencies concerned with population projections. An important advantage offered by this type of forum is that it allows potential critics to interact with one another, enabling them to better appreciate the conflicting pressures that confront us. Frequently these exchanges result in the dismissal of unhelpful suggestions by the participants themselves, thus enabling us to avoid giving the impression of being unresponsive to suggestion.

In 1983, we published projections whose migration component was produced using the residual method(3).<sup>2</sup> The essence of this method is to examine the change in population for a given area over a given period of time to see what part of this change may be attributed to births and deaths, and then to ascribe the remainder to migration. Net migration rates estimated in this fashion are assumed to remain constant for the projection period. While relatively simple and easy to understand, this method can produce erratic results. To illustrate, these projections showed the population of the District of Columbia falling by nearly 50 percent between 1980 and 2000.

We had employed more sophisticated projection techniques prior to the 1983 projections, but lacked the data to use them to our satisfaction. The decision to use the residual method reflected a desire to use a method adequately supported by the data at hand. However, the results from this method indicated that better data on migration was needed in order to improve our projections. For some time the Bureau had been working with administrative records data from the Internal Revenue Service in an effort to improve migration estimates. By linking records across consecutive years and comparing residences in the 2 years, we obtained direct observations on migration, and we realized that these could be used to construct time series on State-to-State migration. Collection of these data had begun in 1975, and by the mid-1980's, we felt we had a long enough time series to justify the considerable effort involved in assembling the data in a form suitable for inclusion in a migration projection model. While there were many reasons underlying this complex project, a desire to improve on our 1983 methodology and continued pressure from our users for more reliable projections played a significant role.

In 1988, we produced our first projections using the new data (4). The availability of time series on individual State-to-State flows opened a wide variety of projection opportunities, the debate about which is still continuing. For the 1988 projections, we modeled each State-to-State flow as a linear function of time and used a regression technique for projection, with limits and interpolation to impose regularity. The decision

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<sup>2</sup>Underscored numbers in parentheses refer to sources listed in References.

to treat migration flows as a linear function of time was a source of great dissatisfaction among some of our users, despite the fact that this model performed fairly well and was a considerable improvement over the 1983 approach. The recession of the early 1980's resulted in considerable out-migration from certain States, which had a pronounced effect on the slope of the regression lines for the flows involved. Representatives from these States and some other like-minded critics claimed that it was highly unrealistic to project these straight-line trends and make no allowance for the possibility of turnaround. Dissatisfaction was also expressed over the use of limits and interpolation, which some thought was confusing and arbitrary.

In our latest set of projections we have attempted to meet these criticisms by offering four alternative sets of projections, each with a different migration model (5). Discussions with co-op members had identified a set of objectives that they and others felt our methodology should strive to meet. Naturally, there is considerable conflict among these objectives. The different alternatives focus on different objectives, and by treating the alternatives as equally likely, we effectively allow the user to decide which of these objectives are more important. This approach appears to have satisfied many of the critics of the 1988 approach. However, it has brought forth new criticism from a different quarter. Many users who were satisfied with our past projections are unhappy about being forced to choose from among four alternatives, and complain that we, as the ostensible experts in this area, should at least offer some guidelines for making this decision. Perhaps more serious are the problems this approach creates for those doing work which they wish to control to our projections, since now they have four different standards to contend with. This, in fact, will be a problem for us if we begin to produce sub-State projections. Also, this methodology does not address the issue that some felt was the biggest problem in our past projections, that is, migration is still being treated as strictly a function of time without any attempt to model the forces which cause migration.

During the academic year 1989-90, we had a time series expert, Professor Edward Frees of the University of Wisconsin, in residence as a visiting scholar. He spent this time analyzing our migration data and proposed a time series model for migration projection based on this work (1). Subsequent evaluation has shown that this model significantly outperforms any we have devised (2). This superior performance plus the appeal of expert credentials make this model an attractive candidate for the next round of projections. Discussion continues on the issue of whether to continue the equally likely alternative series approach. The superior performance and theoretical appeal of the time series model argue for giving it preferred status, but it too suffers from the shortcoming of being insensitive to turnarounds. What is being proposed is to use the time series model as the preferred series with an alternative series designed specifically to capture turnarounds. Under this scheme, those who don't want to be troubled with alternatives could use the preferred series, and those concerned about turnarounds would

have an alternative designed specifically for them. However, this work is still in the testing stage, and the final decision has yet to be made.

There is one longstanding criticism of our work that will not be met by any migration projection model currently under consideration within the Census Bureau. This criticism has to do with our failure to take account of the economic forces that influence migration. The real debate here is not about the importance of the effect that economic forces have on migration, but rather about the availability of a reliable method for modeling these effects. We are sponsoring the research of Professor Michael Greenwood of the University of Colorado, an expert in the economics of migration, in the hope of finding such a method. If found, this method will likely be included in a future round of our population projections.

Our experience exemplifies the point made earlier that Federal forecasts will always be subject to criticism regardless of how they are done. As public servants, Federal forecasters must be receptive to public criticism, but we must be aware that altering forecast methods to placate critics will generate new criticism. At Census, we have found it beneficial to interact with members of our forecast audience, to solicit their reactions to new methods before implementing them and to consult with them when uncertain over the choice of methods. On particularly contentious issues, we have found it beneficial to consult with outside authorities. As well as providing new ideas, this approach has met with the approval of our audience, who tend to regard it as a sign of sincere interest on our part in improving our projections. It is always possible to alter forecast methods for the better or for the worse. To make changes for the better, we must work with our critics and attempt to learn from their criticism.

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